MAY 1960

APPLIED Hydraulics & Pneumatics

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Designing Machine Controls for Automatic Assembly

SEE CONTENTS PAGE 3

THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

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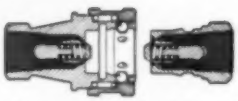

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APPLIED **Hydraulics & Pneumatics** ® VOLUME 13/NUMBER 5

MAY 1960

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BY-PASS VALVE:
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OPERATING PRESSURES:
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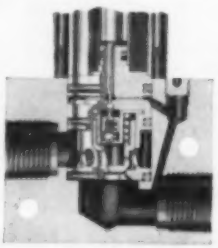

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THE MAGAZINE OF FLUID POWER

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USEFUL LITERATURE

ANCHOR INTRODUCES NEW DISTRIBUTOR CATALOG

In line with its new and broader distributor policy, Anchor Coupling Co. Inc. has recently issued a new Catalog D-1, exclusively for distributor circulation, that covers the entire Anchor Reusable Hydraulic Coupling, Hose and Fitting line that is available to users through Anchor's distributor organization.

This expanded distributor operation is designed to provide a quicker, more convenient service for the present and potential users of Anchor Couplings and Fittings. Distributors are carrying a complete stock of Reusable Couplings, Hose, Adapter Unions, Adapters, Pipe Fittings, SAE Boss Fittings and SAE 4-Bolt "O" Ring Flanged Head Couplings that can be made quickly available as required by local customers, both as parts or in hose assemblies.

The new Distributor Catalog No. D-1 describes Anchor's complete Reusable Coupling Line for high, medium and low pressure service with complete specifications, dimensions and assembly instructions for the various types of couplings.

The following reusable coupling styles are to be made available through this expanded distributor program.

Anchor High, Medium and Low Pressure Reusable Couplings for Style "C" 2-Wire Braid Hose and Style "F" 1-Wire Braid Hose.

Anchor Duloc Couplings for Style "QW" (1-Wire Braid, Cotton Covered) and Style "QWR" (1-Wire Braid, Rubber Covered) Hose for Medium and Low Pressure.

Anchor Reusable Couplings for HI-BURST and Standard 2-Rayon Braid Hose.

Anchor Clamp-Type Couplings for high pressure, Style "C" 2-Wire Braid Hose, Style "CC" 2-Heavy Wire Braid Hose, Style "CX" 3-Wire Braid Hose and for medium and low pressure, Style "F" 1-Wire Braid Hose, "HI-BURST" 2-Rayon Braid Hose, Style "SW" Spiral Wire Suction Low Pressure Hose.

Anchor Hold-Fast Low Pressure Couplings for 1-Cotton Braid Hose.

Anchor 4-Bolt Split-Flange "O" Ring Flanged Head Clamp-Type Couplings.

Anchor High and Medium Pressure Grease Hose Assemblies.

In addition, Anchor offers a complete line of adapters, Adapter Unions, Pipe Fittings and SAE Boss Fittings.

Write Anchor Coupling Co. Inc., 320 No. Fourth St., Libertyville, Ill. for the name of your nearest Anchor distributor, who will be glad to forward a copy of this new Catalog D-1 at your request.

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ANCHOR .... THE PLEDGE OF PERFORMANCE

NOW...

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for **VHP** VERY HIGH PRESSURE

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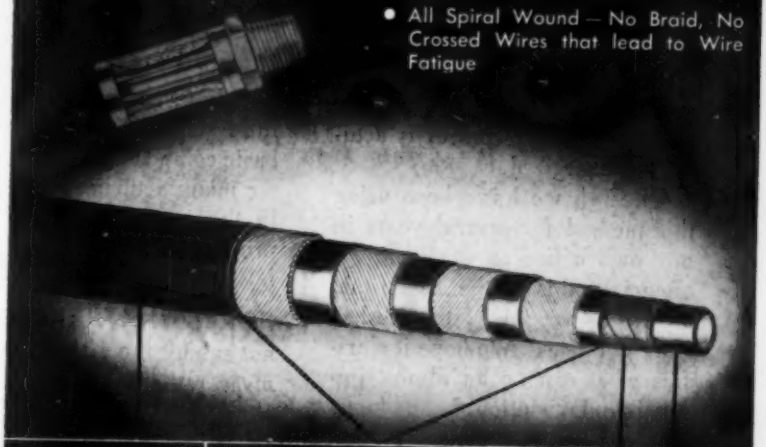
- Heavy Wire, .022" Dia. Reinforcement
- All Spiral Wound — No Braid, No Crossed Wires that lead to Wire Fatigue



OIL AND WEATHER RESISTANT SYNTHETIC RUBBER COVER	4 or 6 PLIES OF SPIRAL WRAPPED HEAVY WIRE (.022" DIA.)	PLIES OF WOVEN FABRIC	OIL RESISTANT NEOPRENE INNER TUBE

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FLUID POWER LINES

about hydraulics & pneumatics

FOR THE FIRST TIME . . . You'll find a new technique in this issue to describe hydraulic (or pneumatic), electrical, and mechanical operation. The sequence charts on pages 90 and 110 tell the story of when relays are actuated, what happens when timers time out, and how valve solenoids are energized. Use the charts with the electrical and fluid power circuit diagrams to follow machine control and operation. Each electrical control has its own column in the chart. Color means the control is actuated or energized.

Though we have been using this method for several years in our own office to work out sequencing, this is the first time, as far as we know, that it has been published. We hope it clarifies what can be an almost impossible description. Let us know how you like it.

FALL OUT FOR ASSEMBLY . . . In the Army, that used to mean a vital announcement like "shoes and raincoats." But peacetime competition has changed meaning. To the manufacturing engineer, *assembly* is too often a synonym of *bottleneck*. He can make parts a lot faster than he can put them together. The answer: mechanization.

The theme of this issue is Designing Machine Controls for Automatic Assembly. You'll find that hydraulic, pneumatic and electrical controls are closely interwoven in the designs which are described.

Some of the questions we've tried to answer are: Where are we going with assembly machines? What standardization can be applied to them? What are the economic considerations? Some men like Project Manager Richard Price of Designers for Industry in Cleveland, believe that automated assembly offers the American manufacturer one of the most direct approaches to cost reduction in this era of rising labor costs and increasing competition. Particularly in industries which have already automated their parts production and materials handling operations, automating product assembly remains one of the most effective means for increasing factory efficiency and improving product uniformity and reliability. A true assembly machine is a tailor-made job, he said, and there is little standardization that can be applied other than in basic components. One word of advice for designers: study the manufacturing process, understand how parts function in the assembled product, then approach the assembly problem with knowledge of new advances in all fields related to the process.

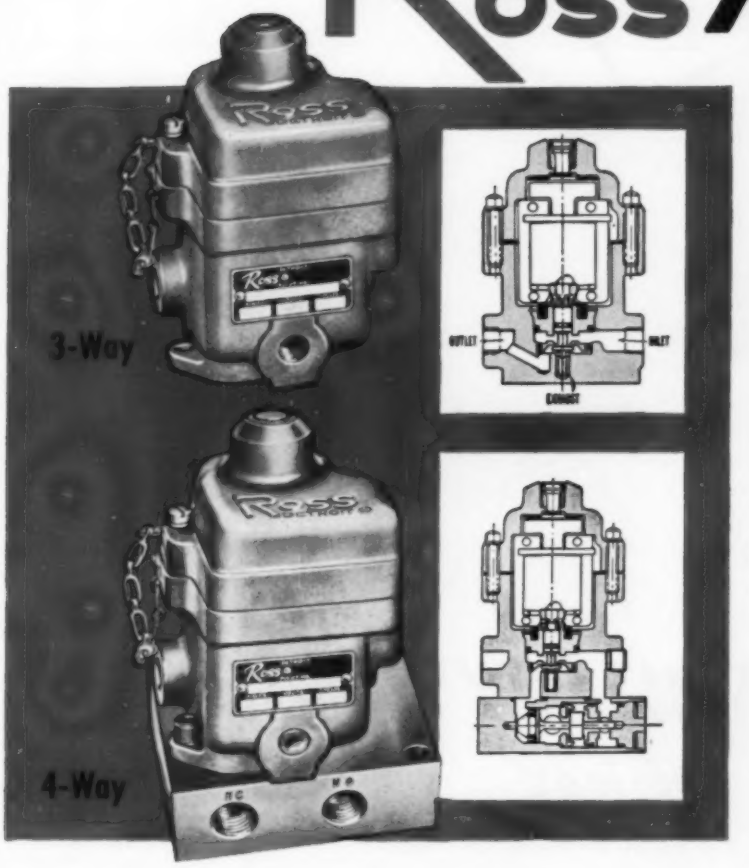
FOREIGN AFFAIRS . . . Our Swiss correspondent did *not* submit the article, *How to Decelerate a Geneva Movement*, rather it tells how Leland-Detroit controlled exhaust flow from a fluid motor driving a heavy index table. The inherent speed characteristics of a geneva movement were not adequate for the heavy loads, and metering was required to avoid pressure surges.

YOU ARE CORDIALLY INVITED . . . Editors of APPLIED HYDRAULICS & PNEUMATICS will be standing by at booth 1111 at the Design Show (New York Coliseum, May 23-26) to discuss hydraulics, pneumatics, and the Cleveland Indians. Our *Along-the-Aisles* feature on page 50 highlights fluids power components you'll see.

Announcing

a new and better solenoid valve in the $\frac{1}{8}$" and $\frac{1}{4}$" size range

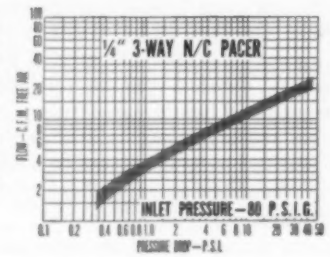
Ross PACER



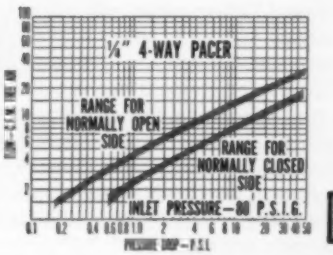
More life
More speed
More capacity
More value

Now you can have about three times more flow capacity-to-solenoid size than in most competitive valves. Needs just 7 watts of power yet minimum internal orifice size is full $\frac{1}{32}$". The PACER has short poppet travel, will cycle at better than 1000 cpm and meets JIC specifications. Lightweight, cast aluminum body means 3-way weighs just 20 ounces, 4-way just 28. Dust tight, liquid tight, can be manually actuated, has captive cover, is inoperative with cover removed, has integral wiring space. Why not test a PACER in your own circuit, just $18 for a 3-way, $26 for a PACER 4-way. Call your Ross representative or write for Bulletin 319.

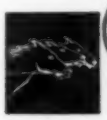
Pressure drop thru 3-way N.C. Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shown as a range rather than as absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



Pressure drop thru both N.C. & N.O. sides of 4-way Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shows ranges for each side rather than absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



STAY AHEAD
MODERNIZE



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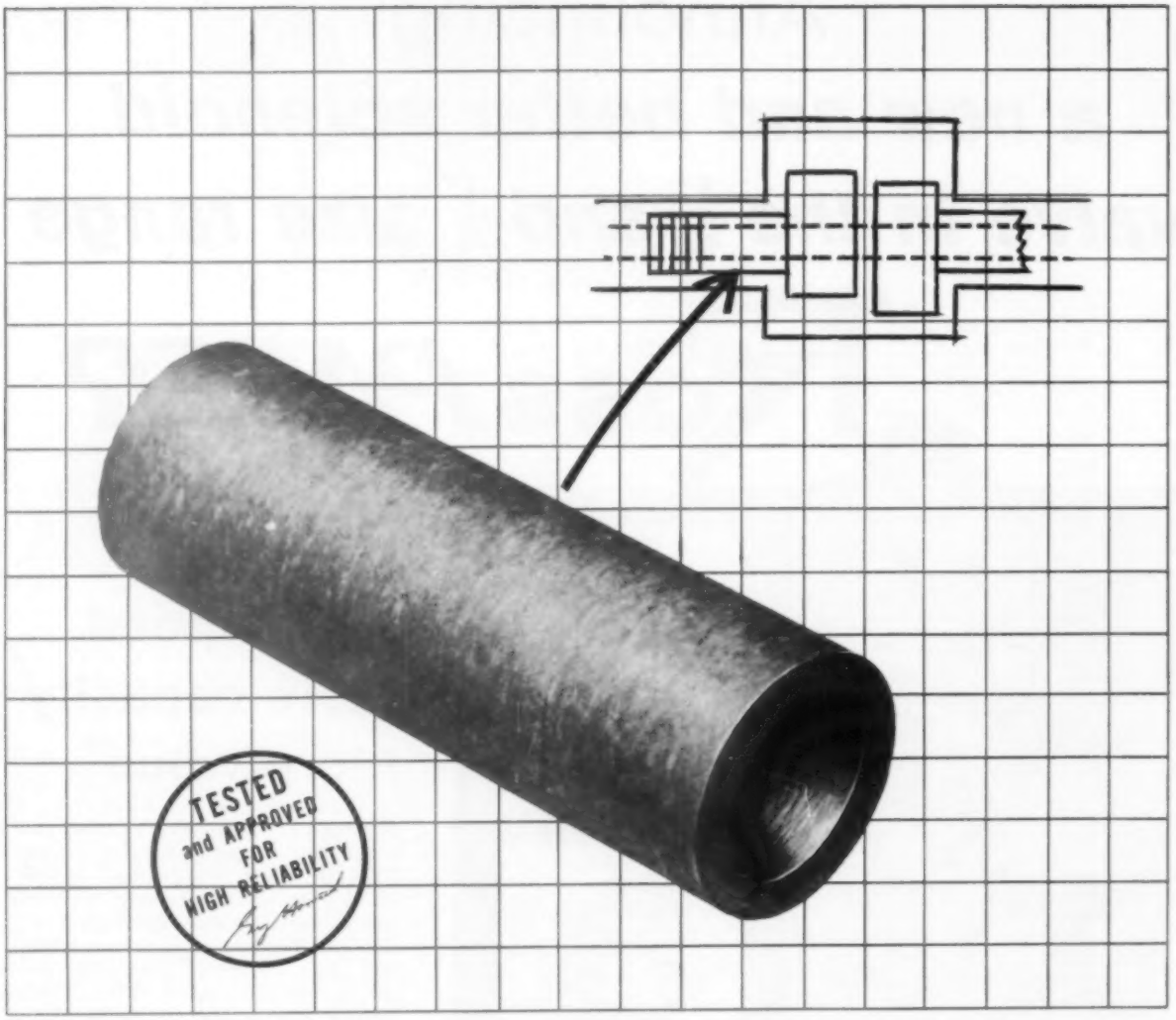


R/M CAPABILITY *produces*

reinforced Teflon bearings*

• to lower friction • to resist extrusion • to resist corrosion • to eliminate contaminating lubricants

R/M reinforced Teflon bearings are giving excellent service in a wide variety of industries. In the chemical industry, their use has greatly extended the range of chemicals that can be handled by a single pump — and lengthened the life of shafts in acid pumps. In the textile and food industries, they have eliminated the need for lubricants and the resulting contamination of materials in process. And in almost every application, they have lowered replacement costs and maintenance requirements while reducing wear.

R/M reinforced Teflon bearings can be machined to very close tolerance. The high rate of thermal expansion and poor cold flow characteristics of pure "Teflon" have been greatly reduced with this reinforced material.

If you have a bearing application, particularly where corrosion and high temperatures present a problem, or where normal lubricants cannot be used, R/M reinforced "Teflon" bearings may be the answer. Send data on your application.

*Registered trademark for Du Pont fluorocarbon resins

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Circle **133** on Time-Saver Card

Circle **121** →

. . . Fluid Power news

REPORT NO. 12,103
"HYTAC"* SYSTEMS ON NEW PAPER MACHINE

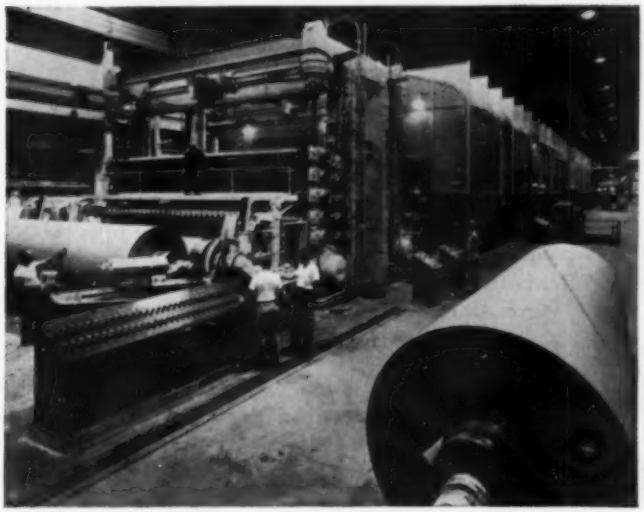
From Oilgear Application-Engineering Files

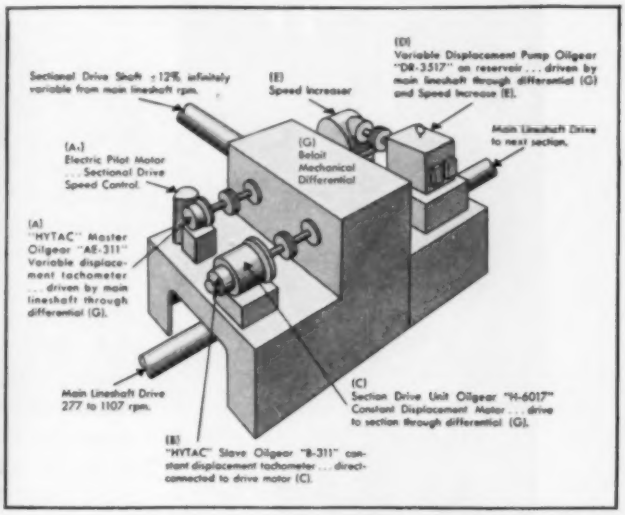
HOW OILGEAR "*ANY-SPEED*" DRIVES ON NEW PAPER MACHINE ACCURATELY CONTROL SECTION SPEEDS

USER: *West Virginia Pulp and Paper Company (Westvaco) (Builder—Beloit Iron Works, Beloit, Wisconsin)*

DATA: Systems to individually vary and accurately control speeds on four sections of a new, 264-in., $25,000,000 paper machine that will produce up to 225 tons daily of a revolutionary, patented, smooth, extensible kraft sheet. Machine is powered from a block-long main lineshaft with mechanical differentials at each section. Main lineshaft speed will vary over a 4:1 range—from 277 to 1107 rpm.

REQUIREMENTS: 1. A system that, when applied to each of four mechanical differentials, will provide individual, precision-controlled, infinitely variable increase or decrease of 10% over or under main lineshaft speed—as selected from 2 local, and 7 remote push-button stations. 2. Each system to maintain selected speed for its section within ±0.25% max. variation over a 50% load change at max. lineshaft speed. 3. Systems must also be: a. Compact. b. Impervious to moisture and daily high-pressure "wash-down." c. Thrifty on electrical power input. d. Trouble-free for continuous, heavy-duty, full-production paper machine drive service.



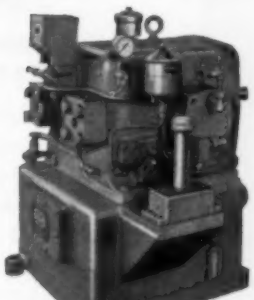

(D) Variable Displacement Pump Oilgear "DR-3517" on reservoir . . . driven by main lineshaft through differential (G) and Speed Increaser (E).
Sectional Drive Shaft ±12% infinitely variable from main lineshaft rpm.
(E) Speed Increaser
Main Lineshaft Drive to next section.
(A1) Electric Pilot Motor . . . Sectional Drive Speed Control.
(G) Beloit Mechanical Differential
(A) "HYTAC" Master Oilgear "A8-311" Variable displacement tachometer . . . driven by main lineshaft through differential (G).
Main Lineshaft Drive 277 to 1107 rpm.
(C) Section Drive Unit Oilgear "H-6017" Constant Displacement Motor . . . drive to section through differential (G).
(B) "HYTAC" Slave Oilgear "B-311" constant displacement tachometer . . . direct-connected to drive motor (C).

SOLUTION: *Application-Engineered* Oilgear *Hytac** (hydraulic tachometer) controlled drives provide precise, individual speed control on each of four sections—3rd dryer, 1st calender, 2nd calender, and winder reel of Westvaco's new #3 kraft machine shown above. Drawing, above right, shows components of typical sectional drive. *These highly accurate, compact, heavy-duty systems have met or exceeded all originally specified requirements.* Examples: 1. Specified ±10% infinitely variable sectional speed control range exceeded by providing ±12% in actual operation. 2. Selected speeds are maintained within specified limits *regardless* of load change. 3. Production speeds increased to over 2000 fpm. Important "Oilgear-plus" features are: 1. Dual winder control that, with the mere flip of a control panel switch, converts winder drive from speed-controlled to tension-controlled . . . speed control prevents tearing the tail strip when starting a new core, while tension control provides good roll quality at full sheet width. 2. Cushioned, controlled acceleration and deceleration. 3. Positive overload protection. 4. Pressure and flood lubrication with continuous power fluid filtration.

OPERATION: Fluid from master tach (A) gives section drive speed command to control on pump (D). Slave tach (B) feeds back a flow signal proportional to actual section drive speed. When main lineshaft speed is increased or decreased, fluid flow from master tach (A) automatically increases or decreases to command section drive to follow lineshaft speed change. Through local or remote pushbutton stations connected to electric pilot motor (A_1) on master tach (A), operator can increase or decrease speed of each *Hytac* section infinitely up to 12% of prevailing lineshaft speed.

A second Westvaco kraft machine will have an *Application-Engineered* Oilgear Controlled Motion System to cover a 10:1 lineshaft speed range, and a wider sectional speed range adjustment.

*"HYTAC" Systems—An Oilgear Trademark



Left: Oilgear Sectional Drive Pump (D) with integral reservoir. *Right:* Oilgear Sectional Drive Motor (C) with direct-connected *Hytac* slave (B) to left.

Fluid Power drives and controls were selected after three years of development on this process and machine—from a 2-in. table model, through a 15-in. laboratory model and 60-in. pilot model. Conventional variable speed drives could not provide the sectional speed control required. "*Equipped with the most advanced precision controls known to the industry . . .*"—is the statement Westvaco has made concerning their new #3 machine.

. . . for the lowest cost per year—it's Oilgear!

For similar practical solutions to YOUR linear or rotary Controlled-Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

Another New Westinghouse AIR CIRCUITRY Component

(One of 30)

The lightweight FLEXAIR® Valve

Provides effortless control. Position of the handle controls air pressure. Pressure is graduated between zero and maximum and automatically maintained. A light touch of the handle controls one, two or three outlets, separately or simultaneously.

The FLEXAIR Valve is only one of a growing list of interesting new AIR CIRCUITRY Components. Westinghouse AIR CIRCUITRY eliminates operator fatigue and errors in manual or semi-automatic operations and serves in completely automatic installations.

AIR CIRCUITRY... FOR TROUBLE-FREE AUTOMATION

Air Circuitry is the application of pneumatic control systems to your industrial production operations.

Air circuits are safe, economical and precise and are used to solve the most rigorous and complex control problems in industry.

Our engineers, backed by 90 years of experience, can help you boost production and cut costs in your plant.

AIR CIRCUITRY means trouble-free automation

For more information, ask for Catalog A4-72.83.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor, or refer to Sweet's Catalog, Product Design File.

WESTINGHOUSE AIR BRAKE COMPANY

INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

Circle **176** on Time-Saver Card

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Needs Liquid Spring Information

TO THE EDITOR:

Could you advise me whether you have published any articles or design data on liquid springs? Either a reprint or the date of your magazine in which the article appeared would be very helpful.

RICHARD THOMPSON
Design Engineer
Bendix-Pacific Div.
Bendix Aviation Corp.
North Hollywood, Calif.

We've sent you a copy of the article "Design of Liquid Spring Shock Absorbers for Landing Gear" by Edward Mucha from the March 1959 issue. We have also referred you to an expert who should be able to give you a wealth of information on liquid spring design and application.

More on Variable Area Cylinder

TO THE EDITOR:

Will you please send any additional material you have on the variable area cylinder described in your December article "Rapid Approach With Variable Area Cylinder".

ARTHUR GREENE
Elgood Hydraulics Corp.
Brooklyn, N. Y.

Name of the manufacturer who supplied information for this article has been sent.

Information on Wheel-Mounted Motor

TO THE EDITOR:

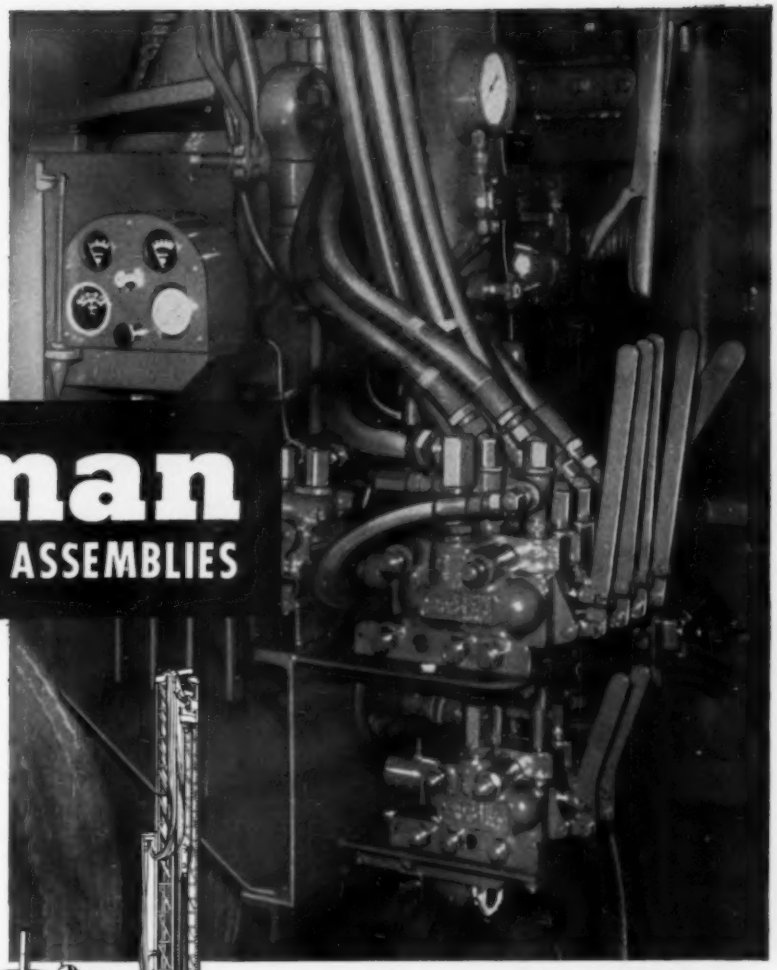
I am an engineering student at Loughborough College and am seeking information about a hydraulically driven motor that can be mounted inside a wheel.

The specification of the wheel is 16-in. diameter and able to give a thrust of 150 to 2000 lb with

Continued on page 14

THE KEY TO A DEPENDABLE SYSTEM!

Eastman
HYDRAULIC HOSE ASSEMBLIES



EASTMAN designs complete hydraulic operation for SCHRAMM Rotadrill

Valves mounted in three convenient banks for each outrigger, forward and reverse rotation of motor, slow down speed, rapid down speed and for breakout cylinder.

The cooperation of EASTMAN Engineering was enlisted in making the operation of this truck-mounted Schramm Rotadrill *completely hydraulic.*

Hydraulic power is delivered through EASTMAN Hydraulic Hose Assemblies to:

1. Three-Speed Reversible Rotation Head: Standard speeds—44, 65 and 120 r.p.m. with 26,500 inch pounds torque. 2. Cylinders controlling down feed, rapid feed and slow feed. 3. Controls for raising and lowering of mast. 4. Breakout Cylinder. 5. Hydraulic Winch and Hook. 6. Three Outriggers.

Dependable field service is assured through EASTMAN Two-Wire Braid High Pressure Hose with Permanently Attached Couplings providing a bond stronger than the hose itself.

Efficient power delivery through the extensive, multiple circuits of this rock-drilling rig is obtained through EASTMAN designed permanently attached hose assemblies which insure longer life and lower cost.

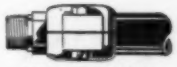
ENGINEERED FOR ENGINEERS BY ENGINEERS

Let EASTMAN Engineering assist you in planning the initial layout of your hydraulic system—for most efficient power delivery and lowest cost.

PERMANENTLY ATTACHED COUPLINGS
for 1, 2, and 3 wire braid rubber cover hose

REUSABLE COUPLINGS
for fabric cover hose

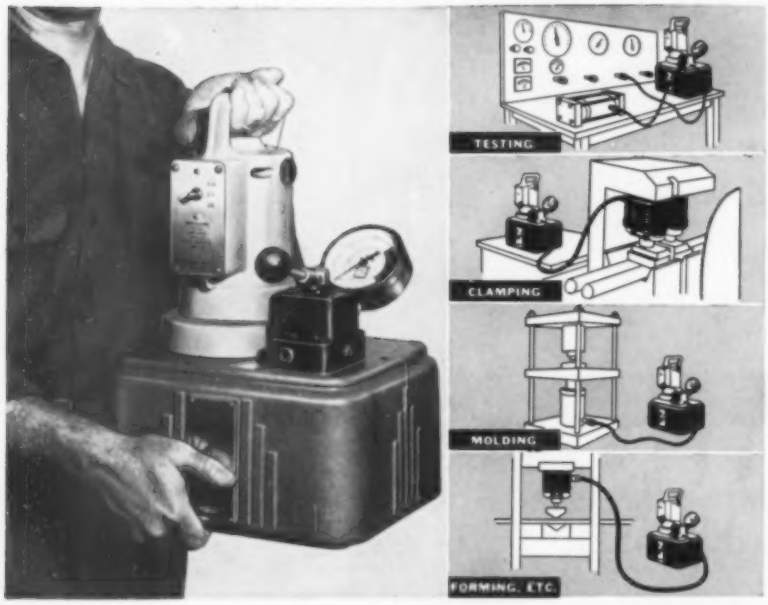
REUSABLE COUPLINGS
for rubber cover hose



CLAMP COUPLINGS
for 1, 2, and 3 wire braid rubber cover hose

Write today for Bulletin 100 and 200 on EASTMAN High, Medium and Low Pressure Hydraulic Hose Assemblies.

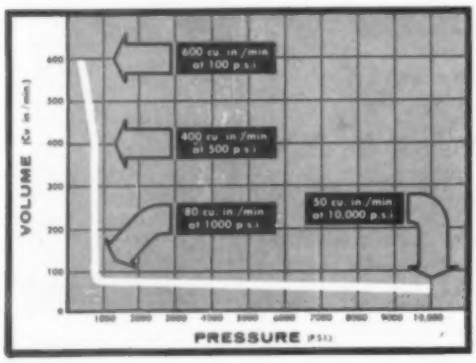
Eastman MANUFACTURING COMPANY
Dept. AH-5, MANITOWOC, WISCONSIN



3½ Times Faster ram approach and return!—with new two-stage hi-pressure hydraulic pump!

- **DELIVERS FROM 2.6 GPM @ 100 PSI, 1.75 GPM @ 500 PSI, 80 CU.IN./MIN. @ 1000 PSI TO 50 CU.IN./MIN. @ 10,000 PSI!**
- **COMPACT: WEIGHS ONLY 45 LBS.; ONLY 17½" HIGH!**

Imagine the time you can save! . . . when your rams move to and from work 3½ times faster! . . . and up to 7 times faster between 150 and 500 PSI! That's what you save with the new OTC "Vanguard" complete pumping unit, as compared to any other single two-stage, hi-pressure unit of comparable size.



All wearing parts are made of finest tool steel, heat-treated and ground and lapped to assure efficiency and long life.

A variety of valves, controls and accessories are available.

Here is a new and revolutionary product! Your interest in reading this far is well founded.

For complete information, contact your OTC distributor . . . or write:

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OWATONNA TOOL COMPANY

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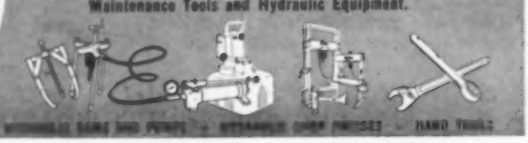


Circle **123** on Time-Saver Card

LETTERS

speeds from 0 to 100 rpm. The load is to be 2 British tons.

ROBERT LEGG
Loughborough, England

We have sent the name of an American manufacturer who makes a wheel with integral fluid motor. We have also sent the name of a British manufacturer of fluid motors which might be adapted to integral wheel design. Enclosed is the article "Fluid Motor in Drive Wheels Simplifies Tractor Design."

Valve for Small Flow Control

TO THE EDITOR:

We are interested in locating a possible supplier of variable, pressure-compensating flow control valves for an approximate range of .005 to .5 gpm. We would appreciate any assistance you may be able to furnish.

R. PAPOUTSY
Engineering Dept.
Pope Machinery Corp.
Haverhill, Mass.

Hydraulic Vibrator

TO THE EDITOR:

We would be very much obliged if you would send us information about the hydraulic vibrator which appeared in the November 1959 issue.

BELA
San Sebastian, Spain

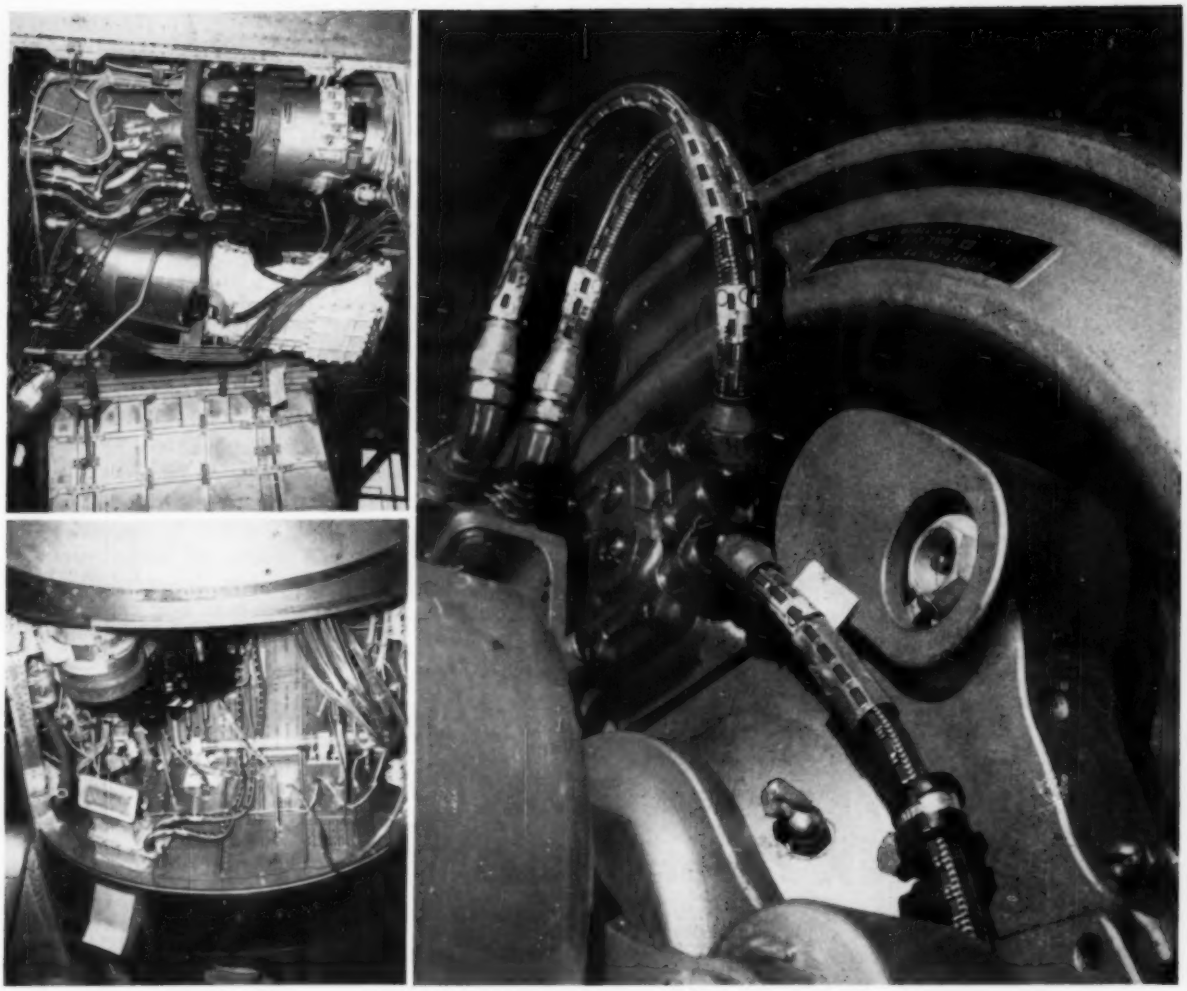
This vibrator was designed as a display for an industrial exhibition which was reported in that issue. We have sent the name of the manufacturer who designed it.

Seeks Unloading Valve

TO THE EDITOR:

Up to now we have been unable to find any supplier of a hydraulic unloading valve, working pressure 350 psi, differential pressure 10% maximum. It should be pilot operated with a separate hydraulic piston. Pump pressure has to drop from 350 psi to 0 psi.

R. WAGNER
Chief Designer
Johnson & Co.
Montreal, Canada



Hoses lined with TEFLON® handle all corrosive hydraulic fluids

A new commercial transport plane uses hose lined with TEFLON fluorocarbon resins for utmost reliability. Shown above (at right) are hose lines to the hydraulic anti-skid brake system operating at 1,750 psi. In addition to these fluid power lines, the illustrations at left show other hoses handling oils and fuel at temperatures to 200°F. and pressures up to 3,000 psi.

In each of these applications, hose lined with Du Pont TEFLON makes possible space savings by the use of smaller outside diameter, flexible hose to handle the high pressures involved.

For the entire spectrum of hydraulic and pneumatic hose applications, hose lined with Du Pont TEFLON resins offers complete resistance to virtually all chemicals encountered . . . exceptional durability under continuous flexing, including torque stress and vibration. TEFLON TFE resins are rated for continuous use up to 500°F.

New constructions especially for industrial applications include fiber reinforcements, elastomeric coverings, convoluted tubing of TEFLON for greater flexibility, and a variety of industrial couplings. For more information, consult your hose supplier, or write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department T-3-5, Room 2526, Nemours Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

DU PONT TEFLON®
FLUOROCARBON RESINS

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resin.

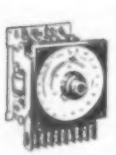
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

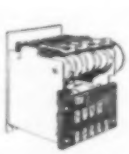
with easy-to-use *EAGLE* CYCL-FLEX reset timers

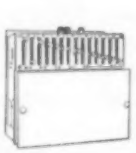
A highly accurate and dependable easy-to-use timer, designed for mounting in control panels. Sealed dial protects timer when exposed to oil and dust conditions. Timer switches control four load circuits. Interlocking contacts are provided without the use of auxiliary relays. Synchronous motor drive insures accurate timing.

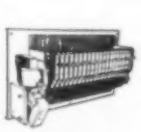
WRITE for descriptive Bulletin 120. Address Dept. AH-560.

EAGLE HAS 24 TYPES TIME-COUNT CONTROLS


Dial Timers and Counters


Cam Timers


Multi-Circuit Timers


Step Switch

EAGLE SIGNAL COMPANY
A DIVISION OF THE GAMEWELL COMPANY
MOLINE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

Circle **57** on Time-Saver Card

FLUID POWER FORUM

Each month APPLIED HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

● *How do you decide when to use a heat exchanger on your equipment? How do you determine its size? What problems have you had with heat exchangers?*

My background in the environmental testing of electrohydraulic servovalves demanded that I be familiar with heat exchangers and their functions. The information below is quite general and is only intended to be a help rather than a rule in selecting a heat exchanger for a particular application.

In the field of electrohydraulic servovalve manufacturing, a rigid control of all prototype fabrication, evaluation, and qualification test programs must be maintained. Correlation in test results from test stand to test stand and also from vendor to customer cannot be overlooked. One area of major concern to all servovalve manufacturers is the maintenance of a fairly constant oil temperature.

In determining the approximate size of the proper heat exchanger to be used, it is necessary to take into account the following:

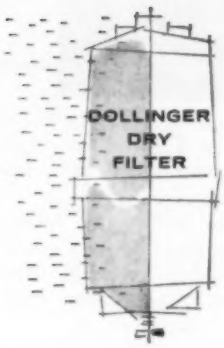
q—Heat transferred (BTU/hr)
A—Approximate surface area (sq ft)
U—Overall heat transfer coefficient (BTU/hr/sq ft/°F)
T—Log Mean Temperature Difference (°F)

$$q = UAT$$

q=(BTU/hr)=lb/hr x specific heat x differential T

As a rule-of-thumb in selecting a heat exchanger, it may be assumed that the heat extracted from a hot fluid is approximately equal to the heat absorbed by the cold fluid. Therefore, for most practical purposes we may equate the cooling *q*

Continued on page 18



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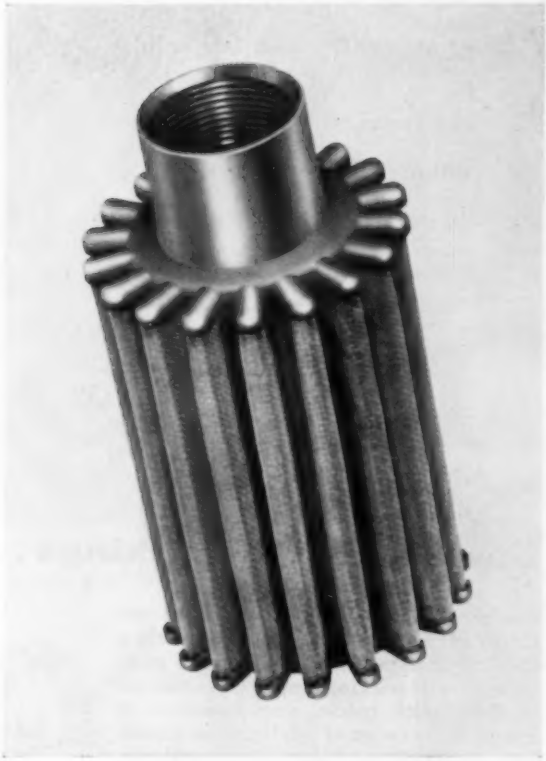
FOR 39 YEARS

ALL NEW DESIGN AT A NEW LOW PRICE

FILTERS
for Sump Pumps
and hydraulically
operated equipment



DOLLINGER SUMP FILTERS are priced lower than competitors' filters for the simple reason they have been specifically designed for your needs. Leading hydraulic equipment manufacturers have already standardized on these filters for their products. Exclusive radial fin design permits larger filter capacity in smaller area. Mesh screen supplied in 60 or 100 G.P.M. Get complete details, write for Sump Filter Bulletin 330. Dollinger Corporation, Centre Park, Rochester 3, N.Y.

PROTECTOMOTOR

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LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Page sets the stage for . . .

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a complete line of leather U, V, Cup and Flange packings including rubber impregnated, resin impregnated or silicone coated

for temperatures from –65° F. to 225° F.

have low coefficient of friction

do not readily cold flow

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will not score or abrade

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Specify PAGE Packings . . .

and benefit from the full cooperation and facilities of an organization with nearly a century of experience. Page has a complete line of packings made from various leathers, with special impregnations to meet a wide range of applications. Standard synthetic packings also available. *Write for your copy of the Page Packing Manual . . . or if you have a problem let us make recommendations.*

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PAGE BELTING COMPANY
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Page Packings — engineered to do a better job

Circle **124** on Time-Saver Card

FORUM

(BTU/hr) to the heating q (BTU/hr) and solve for either a specific heat, fluid flow rate or temperature.

There are many more factors to be studied, including maximum allowable pressure drop, viscosity of the specific fluid, and cooling efficiency.

Some of the problems arising from poor selection of a heat exchanger are: (1) corrosion, (2) inaccessibility for cleaning, (3) restricted flow, (4) incompatibility with various fluids, (5) insufficient pressure rating, (6) mounting restrictions.

THOMAS F. KRUGER
Design Engineer
Servotronics, Inc.
Buffalo, New York

● *What is your practice in installing air pressure regulators? One for each cylinder? One for the whole machine? What are your reasons for this? How does it help you maintain better pressure control? What problems do you have with pressure regulators?*

We install one regulator near the point of usage. Sometimes two tanks feed this one regulator. This gives better moisture control, and we have serious moisture problems. The regulator is more accessible for adjustment at the usage point. Using one regulator lowers the initial cost. We have no problems with the regulators themselves.

D. STODDARD
Design Engineer
International Business Machines
San Jose, California

It depends on the application. If control is not critical, we generally use one regulator for the entire machine, but if we have several cylinders performing different types of work (such as feed and clamp) we frequently find it best to use a regulator for each cylinder. This certainly gives a much more accurate control, and cylinder size is not so critical.

Federal Mogul Corp.
H. F. DEWEESE
Engineer
St. Johns, Michigan

Webster hydraulics "muscle" a boardinghouse reach . . .

It stretches way out for a hearty bite, digs deep and unloads high over a truck side. Hydraulics give this versatile backhoe its sure-footed stance, swivel-hipped performance, accurate bucket and boom control. In many of these mobile rigs, a Webster JD hydraulic pump powers the action — in up to seven separate cylinders!

Not an unusual assignment — for the JD series has an uncanny ability to handle demanding jobs with speed, sureness and exceptional dependability. That's why you find them on a wide range of industrial, agricultural and construction machines . . . in pressure lubricating, oil circulating and lift systems.

Webster JD positive displacement, gear-type pumps are available in 5 sizes — from 5 to 23 gpm — with pressures to 2000 psi, speeds to 2400 rpm. Drive is direct, gear or belt. Side porting standard, end optional. Compact design fits into tight corners.

Need help in a specific hydraulic application? A specially trained Webster hydraulics engineer is ready to assist you. Write for action!

JD SERIES POSITIVE DISPLACEMENT GEAR-TYPE PUMP — Send for complete engineering characteristics performance and installation data.

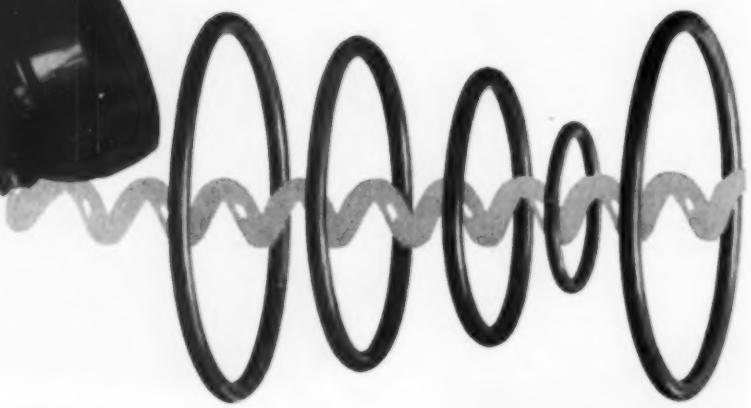
OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS

Call your National Applications Engineer for

engineering help
fast delivery
uniform quality
special compounds
on O-Rings



National's District Field Offices give you fast service on O-Ring engineering problems and O-Ring procurement. You talk with seasoned field engineers equipped with the latest O-Ring information and backed up by the plants of one of America's largest sealing products manufacturers. National O-Rings are precision-made, uniform in quality, specified and used by leading equipment manufacturers across America.

NATIONAL SEAL

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Plants: Van Wert, Ohio; Redwood City and Downey, California

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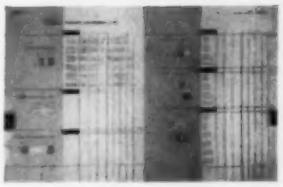
Atlanta 8, Georgia: George W. Smith Company, 394 Williams St., N.W., JAckson 3-7140; **Chicago (Franklin Park) Illinois:** 10013 West Grand Ave., GLadstone 5-4420; **Cleveland 18, Ohio:** 210 Heights Rockefeller Bldg., 3091 Mayfield Road at Lee, YEllowstone 2-2720; **Dallas 19, Texas:** Benson Engineering Company, 2514 West Mockingbird Lane, FLeetwood 2-7541; **Detroit 27, Michigan:** 13836 Puritan Avenue, VErmont 6-1909; **Indianapolis 5, Indiana:** 2802 N. Delaware St., WAlnut 3-1535; **Kansas City (Prairie Village) Kansas:** Benson Engineering Co., 2902 West 72nd Terrace, ENdicott 2-2843; **Los Angeles (Downey) California:** 11634 Patton Road, TOpaz 2-8163; **Milwaukee 4, Wisconsin:** 647 W. Virginia Street, BRoadway 1-3234; **Red Bank, New Jersey:** 16 Spring Street, SHadyside 7-3242; **Wichita, Kansas:** Benson Engineering Company, 519 So. Broadway, AMherst 2-6971

6342

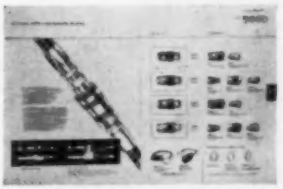
New Design Catalog for Original Equipment Manufacturers Presents the Most Complete Line of Hose and Fittings, Adapters, Self-Sealing Couplings

Hose and Fitting Section—Information on 24 hose types with reusable fittings for pressures up to 5000 psi. for use with hydraulic, air, lube and fuel oils, LP-Gas, water, steam, chemicals and refrigerants.

Adapter Section—O.D. tube and dash sizes are cross-referenced to J. I. C., S. A. E., P. T. T., pipe and straight thread boss (O-ring) ends. Includes 45° and 90° elbows, tees, crosses, union swivels, reducers, bulkhead adapters, caps.



Self-Sealing Coupling Section—Covers variety of standard Self-Sealing Couplings, as well as Aeroquip's ability to adapt couplings to special requirements. Push-pull and screw types, wing or hex nut, mounting flanges.



Hose Assembly Equipment Section—Lists power and hand equipment available to facilitate assembly of Aeroquip Hose and Reusable Fittings.

Design Engineers—here's valuable information to help you solve any fluid piping problem

Your FREE copy of Aeroquip's new 140-page design catalog is ready. Here, in handy form, is the most up-to-date information available to help you save time and money in the design, development and manufacture of fluid systems.

Aeroquip's new fluid system design catalog is divided into four sections; Hose and Fittings, Adapters, Self-Sealing Couplings and Hose Assembly Equipment. Each section contains complete engineering data plus full design information to help you solve just about any fluid piping problem. The catalog is fully illustrated and has complete specifications covering the complete line of products made by Aeroquip for fluid piping systems. Here is comprehensive design information you will want to have at your finger tips at all times—and it's yours free. Just mail the coupon below.

See Aeroquip Products on Display at the Design Engineering Show in New York, May 23-26, Booths 1808 and 1908.

Aeroquip

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Aeroquip Corporation, Jackson, Michigan AH 5

Please send me a free copy of Aeroquip's new Design Catalog for Original Equipment Manufacturers

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engineered to your product

CUT COSTS

Problem Solving is a common occurrence at Precision. One was the development of a universal compound for automatic transmissions and power steering systems. **The Solution**—Precision Compound No. 6767—provided an "O" Ring with these characteristics. Suitable for all transmission fluids . . . long life over a temperature range of —40F to 300F . . . excellent resistance to cracking . . . low volume change—particularly type "A" . . . low compression set . . . high modulus. Precision creative research has reduced costs by producing the right "O" Ring for many manufacturers. You can benefit too, for the services of a Precision engineer are available to help you obtain the right product design and the right "O" Ring for it. Write or phone for his services today.

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio **Canadian plant at: Ste. Thérése de Blainville, Québec**

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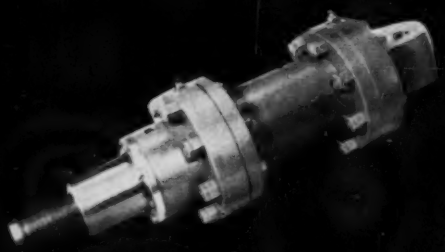
Circle **15** →

Here is power cylinder engineering when you need it!



At Anker-Holth we are used to **hurry-up** calls.

We are used to tough problems in pneumatic and hydraulic power cylinder design.

We are used to devoting time and study to a proposal **even if no assurance of an order is there.**

In most cases we can have a factory trained expert in cylinder design at your plant within hours from the time you call us — no matter where you are located or what your needs are.

Anker-Holth service is as close as your telephone. Phone Port Huron, YUkon 5-7181.

Users of standard cylinders: Find out about Anker-Holth's nine complete lines — the most diversified selection anywhere.

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES

ANKER-HOLTH DIVISION
The Wellman Engineering Co.
2723 Connor St., Port Huron, Mich., U.S.A.

Please send me more information about Anker-Holth Cylinders

C-1

Name_____

Title_____

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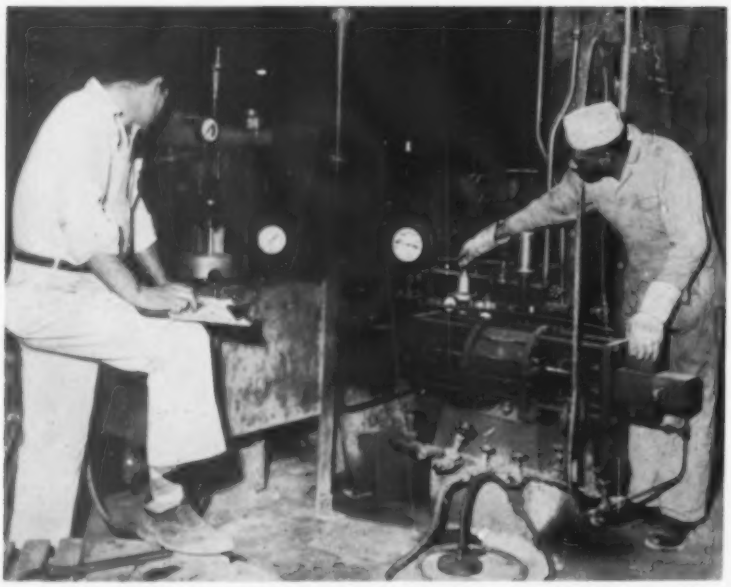
State_____

BRIEFS

about fluid power

Air-Water Circuit Tests Castings at 12,100 psi



OPERATOR OPENS AIR VALVE to provide immediate hydraulic pressure. At left is a special test stand for small castings.

Over half the customers of Philadelphia Bronze & Brass Corp. specify that their castings be hydrostatically tested at average pressures to 5000 psi. Few foundries test above 150 psi on a production basis.

The firm uses a double-acting, air-driven, hydraulic pump (booster), a universal clamping table, and a high-pressure test stand. The booster converts 90-psi air pressure to hydraulic pressure from 50 to 12,100 psi. Castings over 14" are clamped to the universal table. Flexible hoses feed it. The smaller castings are put on the rubber-cushioned, steel, bottom plate of the test stand. Water enters the casting through this bottom plate. A 50-ton hydraulic jack is connected to the steel upper plate. The plate is lowered on its guide rods, and the jack clamps it. The system handles 30 castings per hour.

The booster also rupture-tests tube assemblies, and supplies 500 psi to a large impregnation tank. ▼▼▼

Computer-Controlled Hydraulics Regulates Turbine

An electrohydraulic control system developed by General Electric's Medium Steam Turbine, Generator, and Gear Dept., has ten times the speed, and four times the sensitivity of mechanical controls. The system's early uses will be in industries which need power generation and process steam. The tachometer senses turbine speed, and the pressure transducer senses extraction steam pressure. The solid state analog computer commands hydraulic valves. The valves control cylinders, which operate the turbine valves. Fire-resistant fluid is used. First installation is on a 12,500-kw extraction, condensing unit, with 600-psi inlet pressure, and 200-psi extraction pressure. ▼▼▼

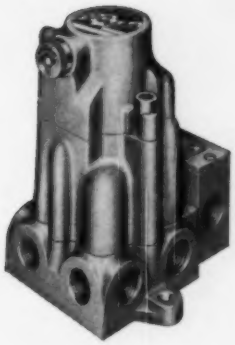
Accumulator Group Meets in Paris

Delegates of accumulator manufacturers in the United States, England, France, West Germany, and Holland met recently in Paris. They exchanged new ideas on application, manufacturing, and marketing. Host and chairman Jacques Mercier of the Olear-France Co., Neuilly, France, guided the tour of plants. The delegates saw rubber manufacturing, and developments in compounding rubber for bladder accumulators. Among the problems they studied were those of supplying accumulators to European industry. They recommended ways

Continued on page 26

Circle 84 →

Compare what the **PDQ WILL DO...**
Compare the **PDQ PRICE...**
With any other air valve...



a ½" valve that will do a ¾" valve job at a ⅜" valve price

- ☑ Accessibility
- ☑ Simplicity
- ☑ Speed and Capacity
- ☑ Price and Quality

What will the PDQ do? It will do a ¾" valve job. It has faster response time and greater capacity than valves twice its size and four times its weight. To repack you simply replace 2 self-contained units in less than a minute. You can change valves on the line in less than 30 seconds.

Will the PDQ last? The PDQ has a short stroke, and a light but rugged aluminum construction with built-in wear compensation. Anticipated valve life is conservatively estimated at 35 million cycles . . . on most applications this is **years** of trouble-free service. Coil (properly applied) is unconditionally guaranteed for the life of the valve.

How about the price? The PDQ is a ½" valve at a ⅜" valve price. Write us today.

A. V. Ney

A. V. Ney, Sales Manager

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

HUNT **Quick-As-Wink** AIR & HYDRAULIC CONTROL VALVES

ANNOUNCING

SHATTER-GUARD

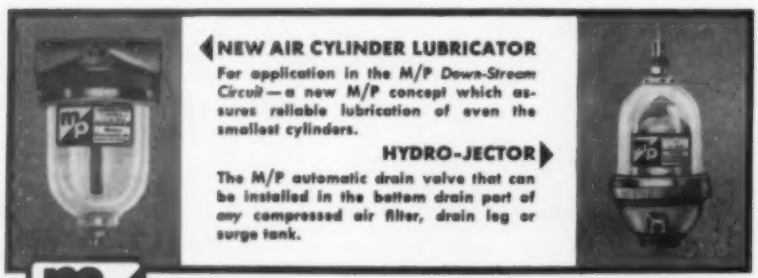
A safety feature now standard on M/P Filters and Lubricators

- Eliminates the "burst" hazard
- Contains all fragments and parts including drain cock when burst occurs
- Resists damage by impact
- Retains visibility advantage

Any transparent filter or lubricator bowl used in a compressed air system may be weakened by *impact, heat* or *chemical attack*. The eventual burst frequently scatters parts and fragments violently.

To eliminate this hazard M/P now supplies the *Shatter-Guard* as a standard part of every *Visi-Bowl* unit. *Only M/P transparent bowls are as safe as metal bowls.*

A brochure outlining bowl-breakage causes and describing M/P Field Conversion Kits is available. Consult your local representative or M/P for complete information.



NEW AIR CYLINDER LUBRICATOR

For application in the M/P Down-Stream Circuit—a new M/P concept which assures reliable lubrication of even the smallest cylinders.

HYDRO-JECTOR

The M/P automatic drain valve that can be installed in the bottom drain port of any compressed air filter, drain leg or surge tank.

MASTER PNEUMATIC, INC.

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BRIEFS

of reducing accumulator maintenance. Panel discussions concerned new products. Attending from the United States was Seymour Garrett, assistant manager, product sales, Greer Hydraulics, Inc., Jamaica, N. Y. Other firms represented were Fawcett Preston Co., Bromborough, England; Robert Bosch Co., Stuttgart, Germany. and Van Rietschoten & Houvens, Holland. ▼▼▼

HYDRAULIC CYLINDER OPERATES HANDWHEEL of globe valve. The test rig opened and closed the valve 22,027 times in 46 hours—an average of 440 operations per hour. Prior to the introduction of the Karbate valve last year, the rig tested it in the laboratories of National Carbon Co., Div. Union Carbide Corp.

Electronic Micro-Hardness Tester Added to Lab

An electronic micro-hardness tester has been added to the laboratory of the Minnesota Rubber Co. According to president Robert W. Carlson the tester can detect minute variations in the hardness of rubber parts. It is very reliable because it eliminates much human error.

It is possible to check hardness of extremely small parts, parts with very thin cross-sections, and parts with irregular shapes. The production of rubber can be more

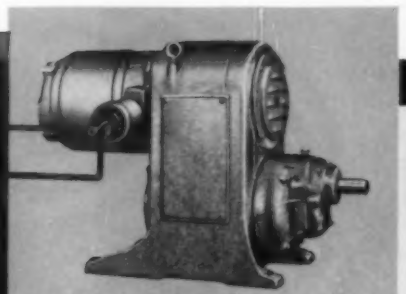
Continued on page 30

Circle **163** →

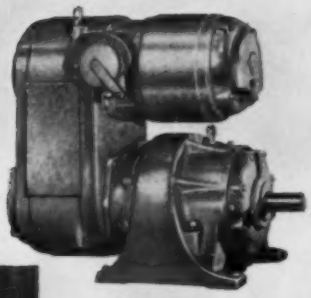
10,000 CONFIGURATIONS— EACH WITH 10,000 SPEEDS!

Choose from thousands of different shapes, sizes, attitudes, mountings, horsepowers, enclosures, ungeared or geared combinations—choose the U.S. VARIDRIVE MOTOR that exactly fits your application! U.S. introduced the *first* self-contained a.c. motorized variable speed drive for industry —in 1932! Ever since, U.S. design engineers have been developing new Varidrives to combine new characteristics... new controls, too: Manual, mechanical, electrical remote control, and automatic control. Ratings available: **¼ to 75 h.p.** *(Send for free 16-page color Varidrive Bulletin, No. F-1797.)* For your variable speed application, specify:

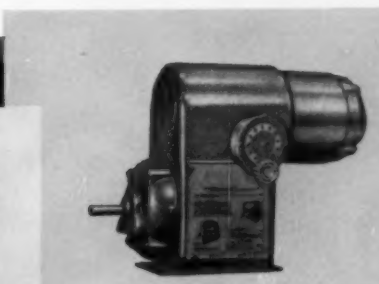
U. S. VARIDRIVE motors



UPRIGHT VARIDRIVE MOTOR
WITH VARITROL AUTOMATIC CONTROL



VARIDRIVE
WITH INTEGRAL GEARING, MOTOR AND TAKE-OFF SHAFT SAME SIDE



SMALLEST VARIDRIVE
1/4 TO 1 H.P.
WITH HAND CONTROL ASSEMBLY

MOTOMOUNT VARIDRIVE
WITH STANDARD
FOOT-MOUNTED

VARIDRIVE MOTOR WITH
INTEGRAL RIGHT-ANGLE
WORM-GEARING

HORIZONTAL VARIDRIVE MOTOR

U.S. ELECTRICAL MOTORS INC.

P.O. Box 2058, Los Angeles, California or Milford, Connecticut

PREVENTIVE
MAINTENANCE

The one sure way to reduce high hydraulic operating costs in hazardous installations

Over 500 million machine hours of operation proves the SAFETY, ECONOMY and RELIABILITY of Pydraul fire-resistant fluids in hydraulic systems of all types.

Prevent hazards . . . with *double-action* fire resistance! Pydraul straight-synthetic fluids will not flash or ignite in active contact with ignition sources—not even when sprayed through a 6000°F. oxyacetylene torch flame (AMS-3150B, 4.9.3.2, and MIL-F-7100). Eliminates worry about explosions or disastrous fire due to ruptured lines or leakage on hot equipment. And Pydraul protects a *second* way . . . doesn't evaporate to leave a flammable residue that could be ignited *after* a leak or line break.

Prevent high maintenance costs . . . with Pydraul *preventive maintenance* protection. Pydraul lubricates like a premium-grade petroleum oil, and has much greater stability than any water-based fluid. Pydraul is 100% synthetic . . . contains no water to cause chronic maintenance troubles. Pydraul doesn't wear out in use; doesn't sludge, to clog filters, strainers or orifices; doesn't corrode metals; doesn't cause rusting. Pydraul F-9, A-200 and 625 operate to 300°F. with low vapor pressure.

Many users report they've never had a bearing fail since switching to Pydraul. Pumps and valves have been in service for eight years without changing.

Prevent erratic production . . . by converting to stable Pydraul. One major manufacturer made a careful full-year comparison of Pydraul and a water-glycol fluid . . . in identical die-casting machines making the same part. *Pydraul cut down-time adjustments per machine from 49 to only 6 and reduced annual maintenance costs by 67.4%!* Production rates went up, to give even greater savings.

If you now use any water-based fluid, Pydraul can lower your maintenance costs, increase your production reliability . . . with these preventive maintenance properties: **• better lubricity under heavy loads • better oxidative stability • better thermal stability • better foaming resistance • lower vapor pressure • compatibility with oils, greases.**

with PYDRAUL®

CONVERSION to Pydraul is simple and inexpensive. Choose from these Pydraul straight synthetics to meet your needs:

PYDRAUL A-200, F9	PYDRAUL 150	PYDRAUL 625	PYDRAUL 60	PYDRAUL AC
Medium-weight fluids for standard indoor industrial hydraulics. Top performance. Pydraul A-200 is new, low-cost straight synthetic.	Light-weight fluid for outdoor use. Operates in 0° F. weather.	Heavy-weight fluid for heavy-duty applications. Designed for pumps demanding high viscosity fluid (800-1000 SUS).	Low-viscosity fluid for precision equipment or very low temperatures —down to minus 20° F.	Air compressor lubricant that prevents carbon build-up on valves, protects against fires and explosions.

Pydraul fluids give you the fire protection you need . . . without the penalty of excessive maintenance costs

Monsanto®

Please send me these new brochures:

"Know Your Fire Hazards"

"Preventive Maintenance in Fire-Resistant Hydraulics"

Technical literature on Pydraul F-9 ( ), A-200 ( ), 625 ( ), 150 ( ), 60 ( ), AC ( )

Monsanto Chemical Company, Organic Chemicals Division Industrial Fluids Department, St. Louis 66, Missouri

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FOR THE BEST IN HEAT TRANSFER PERFORMANCE

Yates-American

FIXED BUNDLE

STAINLESS STEEL HEAT EXCHANGERS

FOR CORROSIVE TYPES OF HYDRAULIC OILS...

- Stainless Steel Construction . . . all parts in contact with fluids . . . of Type 316 stainless steel.
- Rolled tube joints . . . industry's preference and standard of quality construction.
- Tube pattern . . . allows for use of wider, heavier gaskets for critical conditions of temperature and pressure.
- Wider range of capacity . . . ¼" and ⅜" tube sizes . . . unit sizes 2" to 10" diameter.
- Write for Bulletin HT-21

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FIXED BUNDLE

HEAT EXCHANGERS

FOR BROADEST HEAT TRANSFER APPLICATIONS

- Flanged baffles . . . pioneered by Y-A eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2" to 8" diameters.
- Popular sizes now available from stock.
- Ask for Bulletin HT-1A.

Yates-American

ENGINE COOLING RADIATORS

FOR ALL TYPES AND SIZES OF DIESEL ENGINE APPLICATIONS

- Die-drawn, cast, or fabricated construction.
- Complete range of efficient cores.
- Application engineered for specific conditions.
- Panel or sectional construction.

Y-A Engineers are always available to assist in the most practical and economical solution for your heat transfer problems in heating or cooling applications.

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

705 4th St. BELOIT, WISCONSIN

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BRIEFS

closely controlled, so there is less variation in the physical characteristics of the product. This is important when the production run requires milling of many batches of rubber. ▼▼▼

HYDRAULIC POWER FEEDS the head of this drill, coredrill, counterbore, chamfer, and reaming machine. It was designed by Foote-Burt Co., Cleveland, Ohio, to process cylinder blocks. Use of standard components avoids mass obsolescence. The automatic lubrication system supplies all 27 stations, covering the heads and the locating and shuttling mechanisms.

Compressed Air Cuts a Lot of Ice

Now that winter is over, officials of the Charles River Yacht Club have seen how friendly fluid power can be to the pocketbook. In past years, ice damage to their

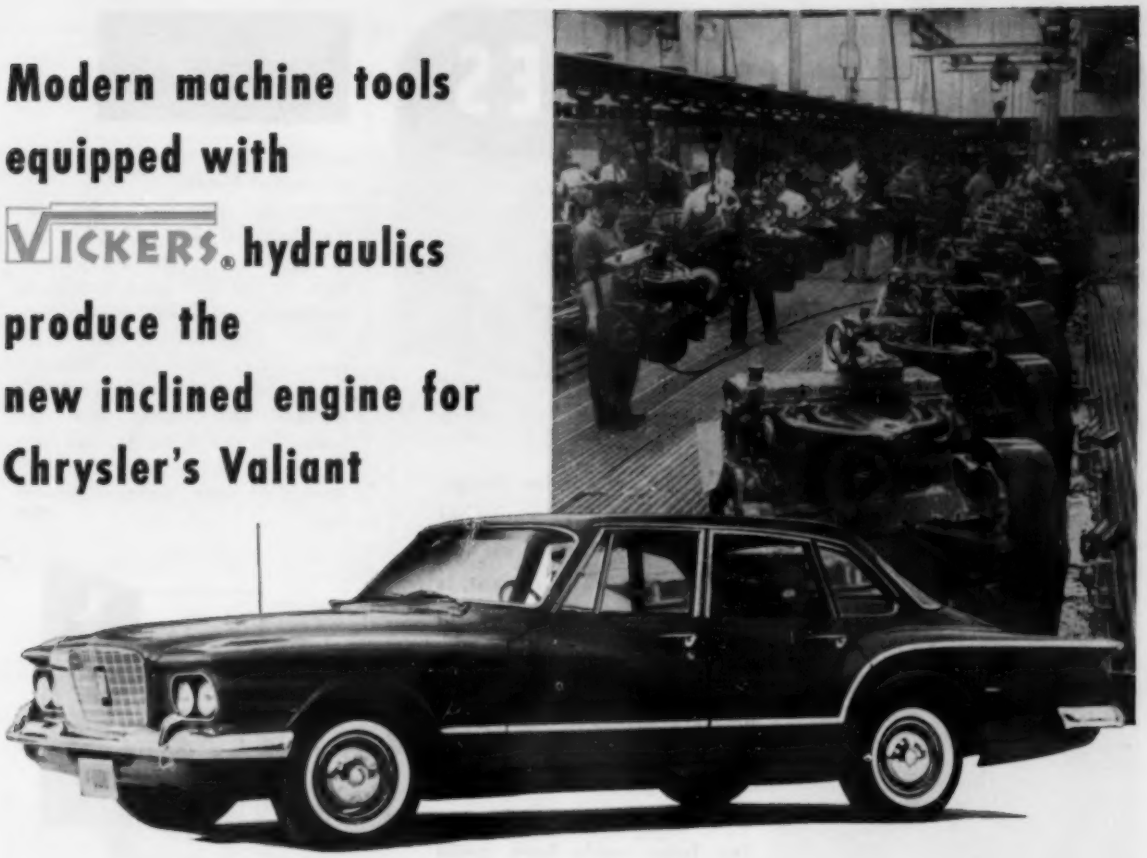
Location: The Charles River Yacht Club, Cambridge, Mass. Temperature: Low! On some parts of the river, the ice is over a foot thick. But around the docks, the water is open. Why?

piers and floats ran into the thousands.

Club officials, men from Dunham-Bush's Brunner Div., and consulting engineer Joseph Legasse knew that if the warmer (38 F) water from the river bottom could be forced upwards, and if the

Continued on page 32

Modern machine tools equipped with VICKERS® hydraulics produce the new inclined engine for Chrysler's Valiant



Machine tools of the most modern design are required to produce the new inclined six-cylinder engine for Chrysler's Valiant in volume and to the required precision standards. A walk through the Trenton, Michigan, engine plant quickly establishes the fact that the majority of hydraulically operated machine tools are equipped with Vickers hydraulics. (See tabulation at right.)

Machine builders and users have long been aware that performance goes up and maintenance decreases when Vickers hydraulics are specified. *One* reason is that each Vickers pump, motor, and control element represents advanced hydraulic design and manufacture. *Second*, unmatched application engineering experience is applied to planning the installation. *Finally*, service wherever necessary is promptly provided by technicians who are Vickers hydraulic specialists. More details are available about specific products and services in the *all new* Catalog 5001.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
DETROIT 32, MICHIGAN

8537

VISIT US IN BOOTH 1725 AT THE DESIGN ENGINEERING SHOW NEW YORK COLISEUM, MAY 23-26

These machine builders use Vickers hydraulics

Apex Corporation
Barnes Drill Co.
Bilt-Rite Tool Co.
Buhr Machine Tool Co.
Centri-Spray Corp.
Cleveland Hobbing Machine
Colonial Broach & Mach. Co.
The Cross Company
Ex-Cell-O Corp.
Fitchburg Engineering Corp.
The Foote-Burt Co.
Gisholt Machine Co.
Greenlee Bros. & Co.
Heald Machine Co.
Industrial Metal Products Corp.
The Ingersoll Milling Mach. Co.
F. Jos. Lamb Co.
Landis Tool Co.
The LaPointe Machine Tool Co.
LaSalle Machine Tool, Inc.
The R. K. LeBlond Mach. Tool Co.
Leland Detroit Mfg. Co.
Michigan Special Machine Co.
Micromatic Hone Corp.
The Motch & Merryweather Machine Co.
National Acme Co.
National Automatic Tool Co., Inc.
Norton Company
Sheffield Corp.
Snyder Corp.
Sturr-Kup Engineering Co.
Sundstrand Machine Tool Div. Sundstrand Corp.
Jervis B. Webb Co.
Wickes Corp.
Wilson Automation Co.
Wilson Engineering, Inc.

HEISE GAUGES

IN RANGES UP TO 50,000 psi.

The Heise Gauge, for many years a world standard for precision pressure measurement, is NOW available for use in ranges up to 50,000 psi.

Control of this extreme pressure is made possible by the new Heise heavy duty Bourdon Tube, a single unit which eliminates all internal connections.

The Tube, made from #403 Stainless Steel, is multi-coiled to reduce unit stress and formed to a scientifically precise section by an exclusive Heise process.

Mounted on the Heise integral gauge movement this unique element initiates a new concept in pressure gauge design.

The 50,000 lb. gauge features the traditional high quality workmanship expected of all Heise equipment.

Accuracy is held to 1/10 of 1% of full scale reading in this ultra high pressure laboratory instrument.

PRESSURE RANGES	DIAL SIZES	PRICES	DELIVERY
15 to 50,000 P.S.I.	8½"-12"-16"	from $166.75	within 30 days

HEISE BOURDON TUBE COMPANY, INC.

BROOK ROAD, NEWTOWN, CONNECTICUT, U.S.A.

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BRIEFS

water could be kept moving, then it wouldn't freeze.

On the river bed below the dock pilings, they laid 1500 feet of ½" plastic tubing. Small openings, 12" to 15" apart, run along its length. A 3-hp and a 5-hp compressor developed 48 cfm at 40 psig. Valves reduced this pressure to 5 psig. When temperature dropped, the system pushed the warmer water upwards, and kept it moving. There was a 15-foot stretch of open water all winter long. ▼▼▼

"Sorry I'm late, dear – a little problem came up at the office"

School to Give Summer Course on Hydraulics

Illinois Institute of Technology, Chicago 16, will give a course on basic oil hydraulics, from June 13 to 24. Principal speaker will be D. W. Prosser of Illinois Tech. He will cover flow principles, pumps and motors, hydrostatic transmissions, controls and JIC symbols, and accumulators. Prosser will give the concluding remarks before the final exam. Lectures and laboratory demonstrations will be from 9:00 to 12:00 AM, and from 1:00 to 4:00 PM.

During the first week, K. G. Henrikson of Socony Mobil will speak on fluids, and Garlock's Orville Genz will present "Sealing Devices, Old and New." J. R. McCoy, Indiana Commercial Filter

Continued on page 36

For Cylinders, Circle **76** →
For Fittings & Hose, Circle **126** →

Hannifin high-pressure hydraulic cylinders feature a drip-free rod gland with "LIPSEAL"® and "WIPERSEAL." This feature, plus straight-thread, O-ring-sealed ports, insures leak-proof cylinder installations.

Parker "Krimp-lok" permanent-end hose assemblies and "Hoze-lok"® reusable fittings can be ordered with O-ring-sealed straight threads to insure leak-proof hydraulic operations to 5,000 psi.

from PARKER-HANNIFIN...

straight-thread ports and fittings for leak-proof hydraulic systems

Both Parker "Triple-lok"® flare-type and "Ferulok"® flareless fittings include straight-thread shapes in steel and stainless steel for leak-free tube connections. Write for our handy "Fittings Finders" for quick selection of Parker tube fittings, hoses and hose fittings.

Parker straight-thread hydraulic fittings, mated with S.A.E. bosses (offered at *no extra charge* on Hannifin cylinders), guarantee leak-proof cylinder port connections.* This use-proved sealing method is J.I.C. recommended.

To insure leak-proof performance throughout your hydraulic systems, Parker offers both "Triple-lok" flare-type and "Ferulok" flareless fittings for leak-proof tube connections. Where you need high pressure, permanent-end hydraulic hose assemblies, Parker supplies "Krimp-lok." And for fast, leak-proof field service or replacement, Parker "Hoze-lok" fittings require no skiving of the hose, need a minimum of tools for assembly.

Your Parker-Hannifin man is qualified to help you with installation problems. He'll also help you plan your hydraulic layouts.

**Both Parker fittings and Hannifin cylinders are still available with "dry-seal" pipe threads.*

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

HANNIFIN COMPANY
545 S. Wolf Road, Des Plaines, Illinois

Fulflo Filters are standard equipment on all 2, 4, 6 and 8 head Pneumacap Rotary Capping Machines, built by Pneumatic Scale Corporation, Quincy, Massachusetts.
Fulflo
B5A

PNEUMACAP Capping Machines

keep the lid on high costs with

Fulflo Filters

Pneumatic Scale Corporation relies on Fulflo Filters to assure maximum clarity of compressed air used in operating their Pneumacap Rotary Capping Machines. Fulflo Filters minimize gumming and remove moisture, oil, microscopic rust, dust, dirt and scale before they can cause trouble. The filters have proved economical through long-lasting elements, and are easily serviceable.

Fulflo Filters employ genuine Honeycomb Filter Tubes to provide true *depth* filtration. They allow any degree of micro-clarity, down to one micron if necessary.

Fulflo offers a variety of single tube filters for operating pressures up to 125, 250, 450, 750, or even 4,000 psi. Multi-tube models are available for large flow rates or central installations.

Write for literature to Dept. AH.

Filter out high costs . . . with CFC Filters

CFC

COMMERCIAL FILTERS CORPORATION

Fulflo Horan-Crane Delpark Michiana

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

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RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

Here's sure power for unfailing cylinder operation. SQUAREMASTER 100's are the world's finest constructed cylinders—perform with 100% efficiency! 200 P.S.I. air to 500 P.S.I. oil. Available in 7 mountings with standard dimensions, in 10 bore diameters, internal and external threading. Special models and cover combinations. Priced competitively; prompt delivery; meet all J.I.C. requirements.

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*Initial High Coefficient of Static Friction

POWER-PACKED FEATURES PROTECTED BY POWER-GUARD CONSTRUCTION

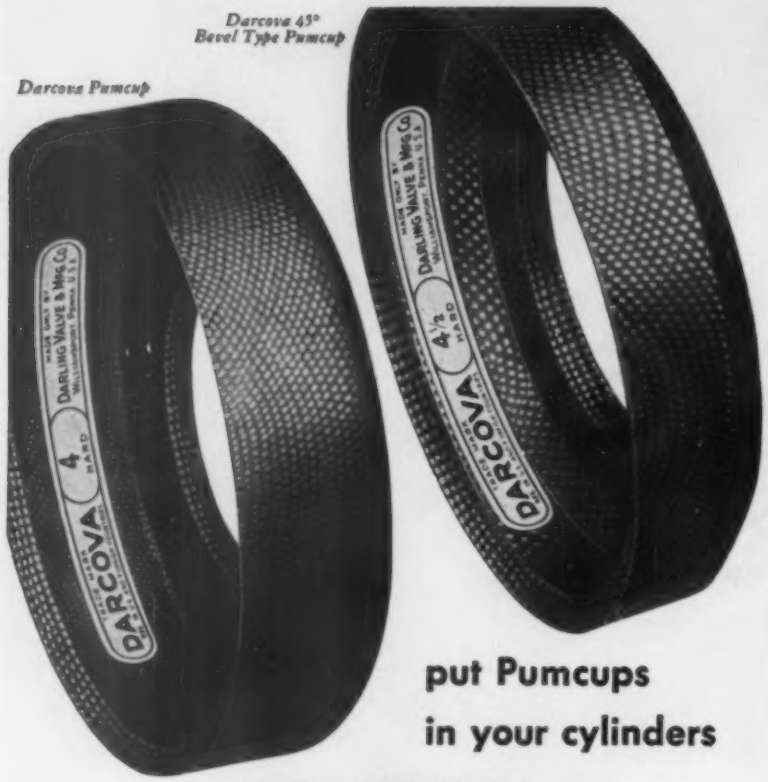
1. Piston rod. Ground and polished alloy steel. Hard chrome-plated. **2.** Piston rod bearing. Replaceable cartridge-type. **3.** Piston packing adjusts automatically. V-block packing minimizes friction. **4.** Correctly stressed tie rods. **5.** Cushion bushings. Bronze, floating type. **6.** Ports rotated to any 90° position. **7.** Steel covers. Take minimum mounting space.

Send for catalog. Proof of SQUAREMASTER efficiency stated in these 20 pages. Write today.

RIVETT furnishes a complete power package

AIR AND HYDRAULIC—VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association



put Pumcups
in your cylinders

TO HOLD PRESSURE LONGER!

In Darcova Pumcups a sound engineering principle has been combined with precision tolerances and extremely durable compositions to provide exceptional efficiency and life in hydraulic, air, and reciprocating pump cylinders of all kinds.

Unlike ordinary piston packing, precision Pumcups are engineered to minimize friction load while hugging cylinder walls on every pressure stroke. Regardless of eventual wear, efficiency *stays* high! So there's far less down-time and need for replacement.

Pumcups are made in a wide range of sizes, types and texture-engineered compositions, including 100% Nylon, for all kinds of pressure-temperature-fluid conditions. Send for Pumcup Bulletin 5903 and weigh all the facts!

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

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BRIEFS

Corp., is to cover filters and filtrations. P. Bauer of International Harvester will talk about reservoirs, heat exchangers, and temperature controls. Directional valves will be covered by Double A's J. Pippenger.

Walter Kudlaty and Roy Wilkes, Miller Fluid Power, will begin the second week's lectures with "Hydraulic Cylinders and Their Applications." G. Stevens of Parker-Hannifin will speak on tubing, hose, and fittings. Other sessions are to cover servocontrol circuits, and hydraulic press circuits.

For more information, contact Mr. Prosser. ▼▼▼

Pneumatic Machine Assembles Rings

An automatic, retaining-ring assembly machine speeds production, eliminates assembly stations, and reduces manufacturing costs. It is made by Waldes Kohinoor, Inc., Long Island City, N. Y. Although each machine installs only

one ring, a fixture can hold many machines. This means that one station can handle virtually any number of rings. The number of rings is limited only by the accessibility of ring grooves in the work piece. The unit uses vertical, ring dispenser brackets and air-driven tools. The brackets are loaded rapidly with stacked rings from wrapped cartridges. The tools are mounted on a gear and rack. The applicators grasp the bottom rings on the brackets, make an arc of 180 deg., and move forward to install the rings in the workpiece. After assembly, the applicator

Continued on page 38

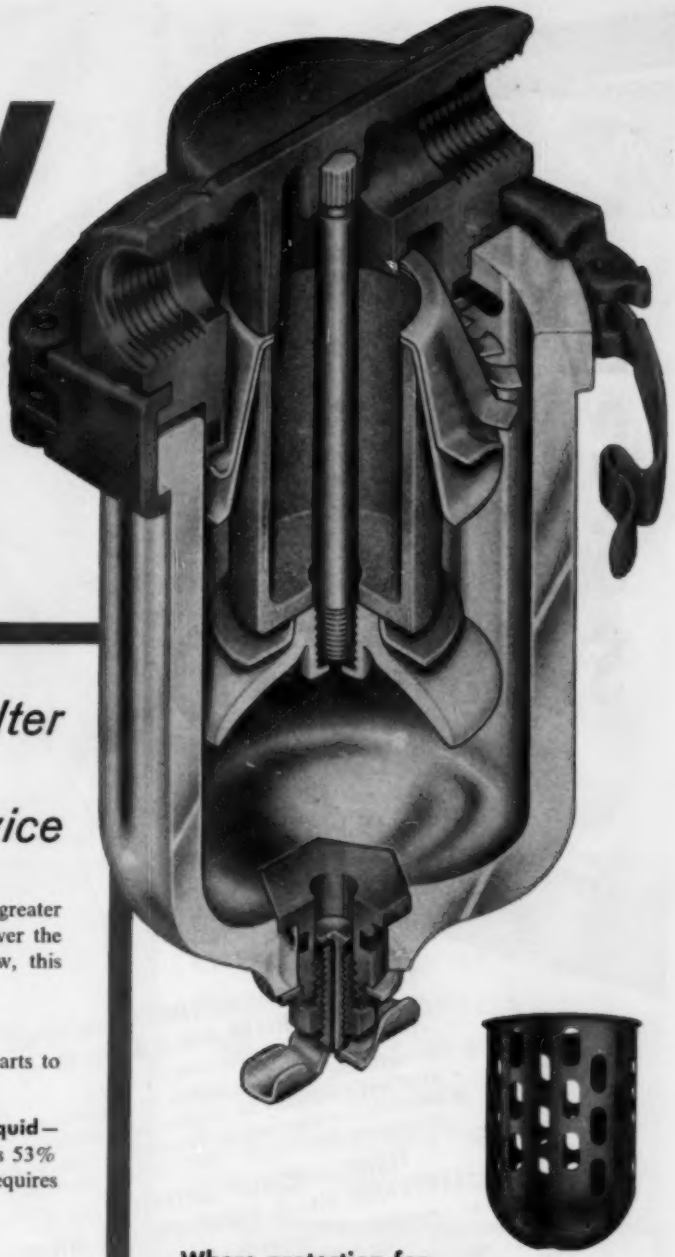
Announcing

NEW

Norgren

COMPRESSED AIR LINE FILTERS

for ¼", ⅜" and ½" pipe sizes



The most efficient filter you can buy...
the easiest to service

1 **100% liquid removal—**
Improved Norgren design provides a greater than ever liquid removal efficiency. Over the entire range of recommended air flow, this filter effectively traps all liquids.

2 **Easier and quicker to service—**
No tools needed and only 4 separate parts to handle.

3 **Larger bowl capacity for collected liquid—**
The "quiet zone" below the baffle holds 53% more collected air-line contaminants. Requires less frequent draining.

4 **New improved bowl—**
New, stronger transparent bowl has greatly improved resistance to fatigue failure.

PLUS *these important benefits:*

- **Highly effective removal of solids.**
- **Optional interchangeable filter elements—** 74, 64, 25 or 5 micron.
- **Reduced service time**—the simplest, easiest filter to disassemble and clean.

Where protection for transparent bowls is required,
a metal bowl guard, held in place by the clamp ring, is available.

For complete information about Norgren's complete line of manual drain and automatic-drain compressed air line filters, call your nearby Norgren Representative, listed in your telephone directory—or WRITE FOR BROCHURE NA-1.

FOUNDED IN 1926

C. A. NORGREN CO.

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LOW
COMPRESSION
SET
SILICONES!
TECHNICAL MEMO ON LINEAR COMPOUNDS
8441-50, 8444-60, 8439-70 & 8419-80
. . . for static seal applications
• outstanding low compression set properties
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• excellent low temperature flexibility—Compound 8419-80 is flexible to −70°F; others to −130°F
FLUIDS GENERALLY SUITABLE WITH COMPOUNDS 8441-50, 8444-60, 8439-70 & 8419-80
Air • Hydrolube U4 • Inert gases • MIL-L-2105 • MIL-L-15016 • MIL-L-17331 • Mobil Nyvac #20 • Mobil Nyvac #30 • Monsanto OS-45-1 • Penola 100 • Petroleum base oils (with aniline points above 240°F) • Pydraul • Pydraul AC • Shell Tellus #33 • Skydrol • Tricresylphosphate
Technical Bulletin No. 56705-1 contains full details —including a list of incompatible fluids. Write today to: Linear Inc., State Road and Levick Street, Philadelphia 35, Pa.
PERFECTION IN RUBBER
LINEAR
LINEAR Inc. STATE ROAD & LEVICK ST. PHILA 35 PA.
Circle **100** on Time-Saver Card

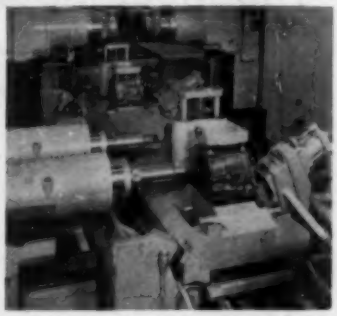
BRIEFS

arms flip back for more rings. A manually or electrically-controlled 4-way valve controls the driving air cylinder. The unit shown installs rings which secure rollers on a flat base plate. ▼▼▼

Fluid Power Keeps Tolerances Tight

A transfer machine for finishing operations holds some bore tolerances to ±0.00035". It holds three hole locations to ±0.001". Part length is accurate to ±0.0039". The machine works cast-iron transmission cases for a small European auto.

The Cross Co., Detroit, needed precise locating equipment for its machine. Not all the holes could

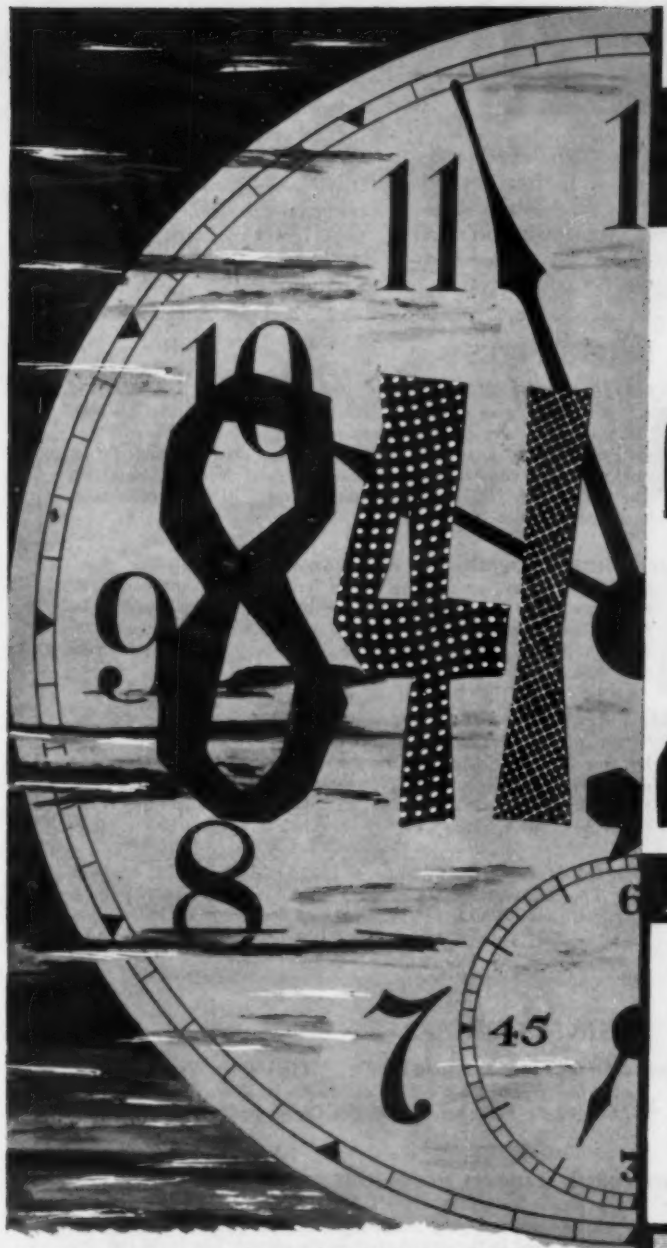


be bored with clustered spindles at one work station.

Workpieces are clamped, two at a time, with the cover faces down, in precision pallet-fixtures. Six buttons in the machining stations locate the pallet horizontally. Air blown over the buttons keeps chips from lodging on them. A wedge-and-slot locator fixes the pallets longitudinally and transversely—a hydraulic cylinder pushes a one-sided wedge into a slot in the pallet.

When the pallet reaches the correct longitudinal position, it hits two transverse stop buttons. This wedges the pallet downward, and clamps it. Low-pressure compressed air goes into orifices in the wedge's straight and inclined faces, and in the transverse stop buttons' locating faces. These ori-

Continued on page 40



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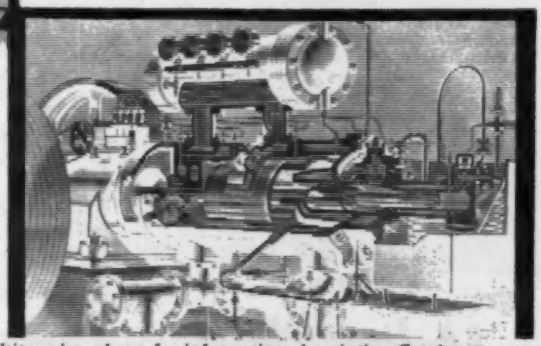
THE WORLD'S FINEST
COMPRESSORS FOR
EVERY INDUSTRY . . .
FOR EVERY PURPOSE.

PROVED IN USE FOR SUPERIOR QUALITY, DEPENDABILITY AND SAFETY . . .

Whether you count the hours, the days, or the years, world-wide industry has counted on NORWALK as the reliable source of compressors that fulfill every specification: from single stage to six stages; from 125 to 42,000 PSI pressure; for a full range of gases: Acetylene, Air, Argon, Specific Hydro Carbons, CO and CO_2, Ethane, Ethylene, HCL, Helium, Hydrogen, Nitrogen, Nitrous Oxide, Oxygen.

Phone TEmple 8-4766 in South Norwalk for immediate consultation of your inquiry.



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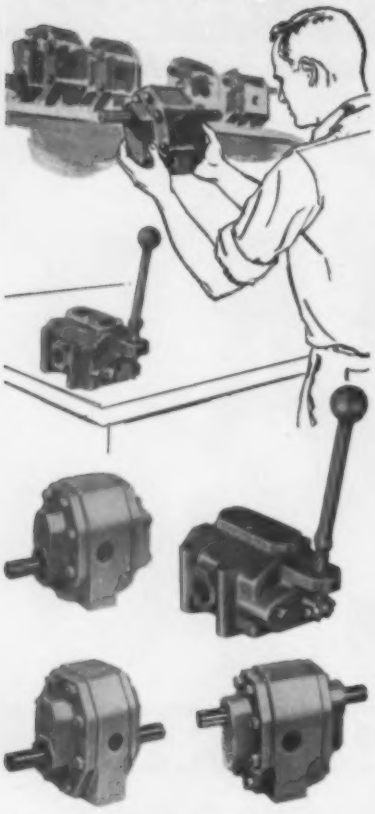
"Off the Shelf"
HYDRAULIC EQUIPMENT



in capacities from 8 to 25 gallons... up to 1000-1500 psi

Engineered by the world's largest manufacturer of hydraulic jacks, Hein-Werner pumps, motors and valves offer compact, high precision, light weight, balanced design. *Valves offer*: large oil passages, close grained high tensile body castings, spring centered ball detent hold, pressure relief valve and hardened seat INSERT for long life. *Motors and Pumps* feature forced lubrication and internal bleeding for axial balance and to eliminate high pressures against oil seals; rotation in either direction, heavy duty roller bearings and gear type constant displacement.

FOX RIVER MFG. CO.
A DIVISION OF
Hein-Werner CORPORATION
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BRIEFS

fices are open to the atmosphere until the pallet is located and clamped. Then, the pressure build-up activates a limit switch to start machining. ▼▼▼

British Hydraulics Group Formed

British manufacturers have formed the Association of Hydraulic Equipment Manufacturers. It will collect and distribute technical information, advise on exhibitions and encourage and

Continued on page 44

BRIEF NOTES

NEW MATERIAL FOR AIR LINE LUBRICATOR AND FILTER BOWLS . . . Some lubricating oils are attacking plastic bowls. Bowls also fail because of excessive pressure, temperature, and impact. Some users are putting metal guards on the bowls. Arrow Tools in Chicago is supplying their lubricators and filters with plastic bowls impregnated with wire cloth. Master Pneumatic, Detroit, offers a perforated metal guard on their models.

FLEXIBLE HOSE FABRICATION WINS AWARD . . . Titeflex, Inc., Springfield, Mass., received an award for "a major contribution in the manufacture of plastics" sponsored by Plastics Technology. The fabrication technique is the winding, convoluting, and sintering of Teflon tapes to provide a highly flexible innercore for Springfield 400 flexible hose.

TUBULAR HEAT EXCHANGER STANDARDS . . . A new edition of the "Standards of the Tubular Exchanger Manufacturers Association" has just been published. The Standards provide detailed information on the design and engineering of tubular heat exchangers. Copies of the book may be obtained from the Tubular Exchanger Manufacturers Association, 53 Park Place, New York 7, N. Y., at $6.00 a copy.

PURE BERYLLIUM TUBING . . . made by Chesterfield Tube Co., Chesterfield, England, will be sold in the United States by Superior Tube Co., Norristown, Pa. It is extruded from hot, sintered billets. OD range is .250" to 1". The element's low neutron absorption, good thermal properties, and high strength-to-weight ratio give it excellent potential for nuclear reactors and aircraft and missiles.

BUSINESS BRIEFS

CLARK CONTROLLER EARNINGS UP . . . Clark Controller Co., Cleveland, Ohio, reported a $938,000 net profit for 1959. Net sales were $17,655,000. In 1958, net sales of $14,925,000 resulted in earnings of $562,000.

HOWELL BUYS FLAT-TYPE MOTOR LINE FROM DIEHL MFG. CO. . . . For an undisclosed sum, Howell Electric Motors Co. has purchased from the electrical division of Singer Mfg. Co. the tooling, machinery, and design used in the manufacture of the motors. The Diehl flat-type line features minimum size, light weight, simplified construction, and ease of disassembly. Howell will produce the motors at its Leland Ohio Electric Div. plant in Dayton.

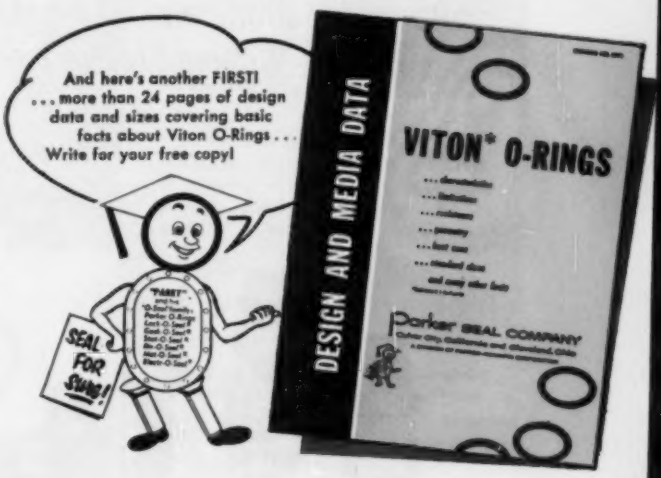
RECORD SALES OF $5,800,000 . . . were reported for 1959 by Cornelius Co., Aero Div., Minneapolis. 1958 sales totalled $3,818,000.

GARLOCK DECLARES 30c DIVIDEND . . . Garlock Packing Co., Palmyra, N. Y. paid a dividend of 30c per share to stockholders of record as of March 11. Last year's first-quarter dividend was 25c. Gross sales for the first two months of 1960 were 10% higher than for the 1959 period.

REMCO BUYS CYLINDER LINE . . . Remco Mfg. Co., Willits, Calif., has bought the complete cylinder line of Turlock Iron & Machine Works. The medium and heavy-duty air and hydraulic cylinders will retain the name *Hypower*.

NOW— VITON O-RINGS IN ALL A.N. OR A.R.P. STANDARD SIZES

One of the first to embark upon a research and development program for Viton O-rings, Parker Seal Company now makes another significant advance in this versatile high temperature material by offering Viton O-rings in all A.N. or A.R.P. standard sizes. This means faster delivery and greater economy for all these popular O-ring sizes. It's another plus result of **responsible leadership** *in O-ring engineering by Parker.*


And here's another FIRST! ... more than 24 pages of design data and sizes covering basic facts about Viton O-Rings ... Write for your free copy!
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Culver City, California and Cleveland, Ohio

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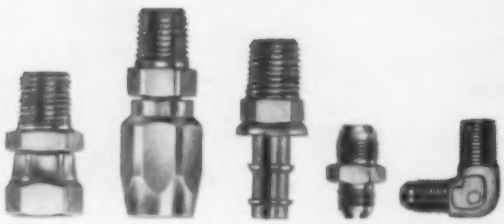
NOW FROM STEWART-WARNER...

New SURGEPRUF® couplings and hose

Now from one reliable source, you can obtain hose assemblies for all types of applications, ranging from fuel lines to high-pressure hydraulic lines—and with the assurance that you are getting only finest quality supplies, manufactured by Stewart-Warner. Available in complete assemblies for immediate use. Nationally distributed. See your supplier, or mail coupon for new Surgepruf catalogs.

A Full Reusable Coupling Line... Assembled to Surgepruf Non-Skive and SAE 100RI, 100R2 and 100R5 Hydraulic Hose...Without Special Tools!



Reusable Couplings and Adapters are available in a full range of thread styles and sizes for all types of hydraulic connections.

Only Surgepruf Reusable Couplings and Hose Have These Outstanding Features:

Superior Fluid Seal, with no wire braid exposure, eliminates seepage between coupling shell and wire braid.

Non-Skive Assembly provides fastest field assembly with just ordinary tools.

Superior Finish—Precision-machined steel couplings have zinc dichromate finish . . . meet rigid salt-spray testing requirements.

Full Interchangeability—regardless of hose line—Surgepruf couplings are available in any style and thread.

High Pressure Hose and Reusable Couplings. Reinforced with high tensile, two wire braid. Synthetic rubber outer cover for top resistance to hydraulic fluid, weather aging and abrasion. Available in non-skive and SAE 100R2 construction. Burst and working pressure equivalent to SAE 100R2. Available in hose ID's from ¼" to 2".

Medium High Pressure Hose and Reusable Couplings. Reinforced with high tensile single wire braid. Available in non-skive and 100R1 synthetic rubber cover, or SAE 100R5 cotton cover. Burst and working pressure equivalent to SAE 100R1 or 100R5, available in hose ID's from ¾" to 1¼".

Medium Pressure Swaged-on Hose Assemblies. Neoprene rubber-covered fabric braid hose complies with SAE 100R3 requirements. Available in hose ID's from ¼" to 1". These assemblies are made only with factory-applied steel swaged-on couplings.

Assemblies also available in one and two wire braid hydraulic hose.

Low Pressure Hose and Reusable Couplings. Reinforced with a single fabric braid. Burst pressure, 1000 psi; working pressure, 250 psi. Available in hose ID's from ¼" to ¾".

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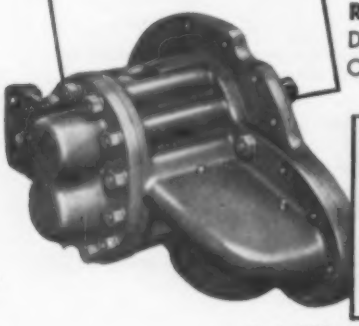

ROPER
ROTARY PUMPS

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BRIEFS

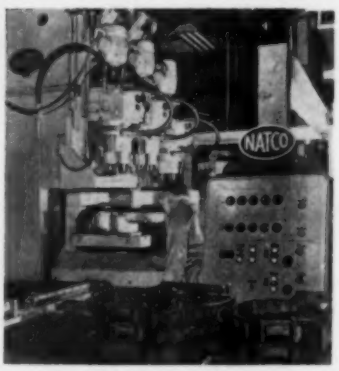
sponsor research. The association will act as liaison between American and European industries.

The group took part in recent conferences on the international coordination of standards. Representatives at the Frankfurt and Paris meetings were from Belgium, France, Germany, Holland, Sweden, Switzerland, Austria, and Italy. Results will be examined at the next conference, to be held in London, May 27th.

The association's offices are at 38/40 Eccleston Sq., London, S. W. 1. ▼▼▼

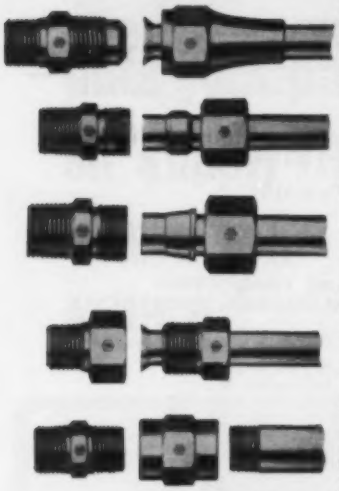
Tapes Make Long Run out of Short Runs

Short-run automation turns out diesel-engine flywheel housings in a Detroit plant. The starter pinion hole, and three, surrounding mounting bolt holes have 160



possible locations on the housing's periphery. Only 50 to 500 castings make a job lot. One numerically-controlled machine handles the work. It holds hole locations to 0.005", and can turn out a part in less than 3½ minutes. A short tape loop positions the work table and controls the drillhead-feed sequence. As a new run of housings comes to the machine, the operator identifies the part, slips the proper tape into the reader, and rotates the spindle heads. A flick of a valve, and the housing rises on an elevator into machining position. ▼▼▼

brass tube fittings



S.A.E. 45° FLARE
USE with copper, brass, aluminum, steel and plastic tubing. U.L. listed; A.G.A. approved. Meets SAE Hydraulic standards and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 3000 p.s.i. Sizes: ⅛" to ¾".

COMPRESSION
USE with copper, brass, aluminum and plastic tubing. U.L. listed; A.G.A. approved. Meets SAE Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 2000 p.s.i. depending on O.D. of tube. Sizes: ⅛" to ¾".

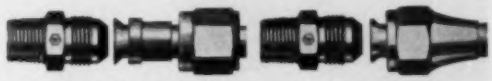
SELF-ALIGN®
USE with copper, brass, aluminum and plastic tubing. No flaring, soldering, welding, or special tube preparation needed. PRESSURE RATING: up to 2000 p.s.i. Sizes: ⅛" to ¾".

INVERTED FLARE
USE with copper, brass, aluminum, steel and plastic tubing. Meets SAE Hydraulic Tube Fittings and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 3000 p.s.i. Sizes: ⅛" to ¾".

PIPE FITTINGS
USE with brass or steel pipe. Meets specifications of SAE TPHL Fittings Committee. PRESSURE RATING: up to 5000 p.s.i. Sizes ⅛" to ¾".

forged steel fittings

ERMETO HYDRAULIC TUBE FITTINGS
Most dependable high pressure fitting in the world . . . easiest installation. FOR FLARELESS TUBE SYSTEMS. No flaring, threading, welding or soldering. Available with carbon steel; stainless steel; cadmium plated or Weathercote finish. Standard Sizes: ⅛" through 2". Pressure Ratings: up to 10,000 p.s.i.



FLARE-TWIN HYDRAULIC TUBE FITTINGS
SAE 37° FLARE (J.I.C.) STEEL FOR FLARE TUBE SYSTEMS. No threading, welding or soldering. Two-pc. and three-pc. carbon and stainless steel with cadmium plated or Weathercote finish. Standard sizes: ⅛" through 2". Pressure Ratings: up to 10,000 p.s.i.

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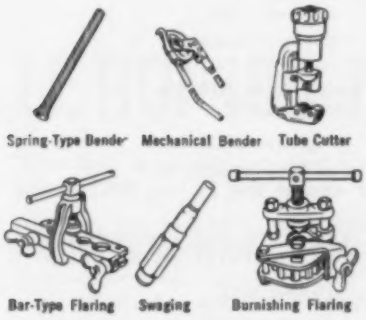
Designed to make fast, easy work of every tubing job. We offer a complete line of low cost, quality made tools for cutting, bending and flaring tubing up to ¾" in O.D.



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Bar-Type Flaring · Swaging · Burnishing Flaring

hose

Available in over 20 different types for any industrial application up to 10,000 p.s.i. pressures and sizes from ⅛" to 2" I.D. Five standard hoses meet most requirements.

H-9—Low Pressure

H-17—Medium Pressure

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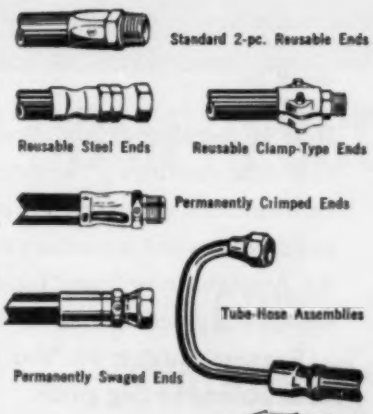
H-69—Medium High Pressure

H-108—Medium High Pressure

hose assemblies



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Tube-Hose Assemblies

Permanently Swaged Ends

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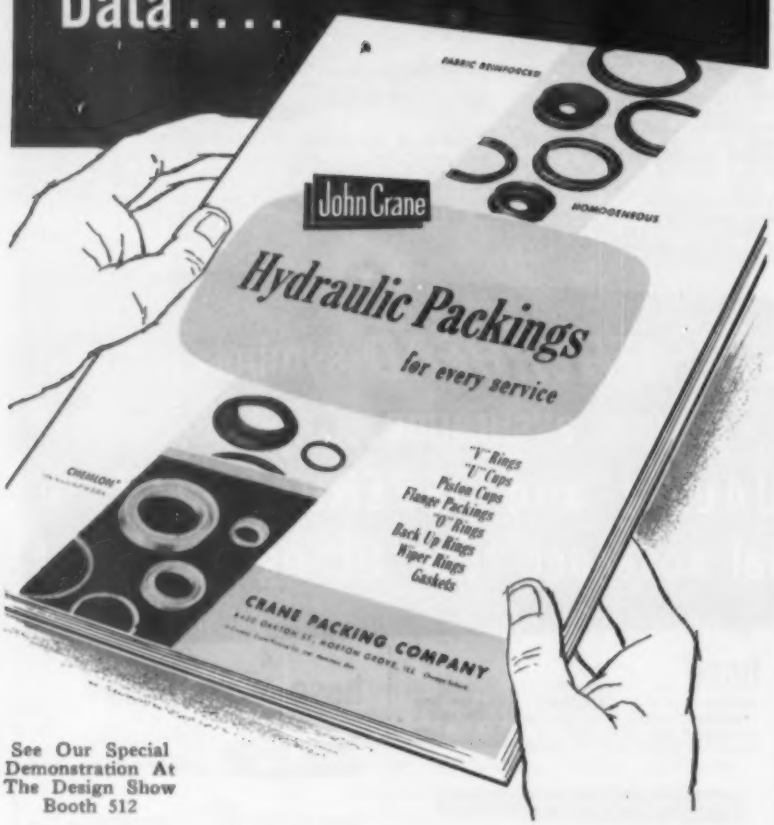
See Weatherhead catalog in Sweet's Product Design File, Plant Engineering File, the Fluid Power Directory, or write direct.

New Hydraulic Packing Designs..... Specification & Application Data....

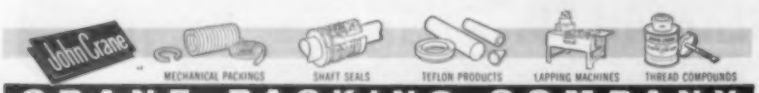


See Our Special Demonstration At The Design Show Booth 512

Here is complete information on the finest available line of hydraulic packings . . . an extremely wide variety of types and constructions, each correctly compounded to particular service requirements and laboratory controlled to insure uniform quality. Available now from "John Crane", this complete line is the answer to practically every hydraulic packing requirement.

Request Catalog 90. You can't afford to be without this detailed engineering guide.

Crane Packing Co., 6405 Oakton Street, Morton Grove, Illinois *(Chicago Suburb). In Canada: Crane Packing Company, Ltd., Hamilton, Ont.*



Circle **47** on Time-Saver Card

FUTURE EVENTS

MEETING, FLUID CONTROLS INSTITUTE, INC.

May 11-14

The Greenbrier
White Sulphur Springs, W. Va.

ASME PRODUCTION ENGINEERING CONFERENCE

May 17-19

Schroeder Hotel
Milwaukee, Wis.

DESIGN ENGINEERING SHOW

May 23-26

Coliseum
New York, N. Y.

ASME SEMI-ANNUAL MEETING & AVIATION CONFERENCE

June 5-9

Statler Hilton Hotel
Dallas, Texas

MACHINE TOOL EXPOSITION

September 6-16

International Amphitheatre
Chicago, Illinois

PRODUCTION ENGINEERING SHOW

September 6-16

Navy Pier
Chicago, Illinois

2ND COLISEUM MACHINERY SHOW

September 7-15

Chicago Coliseum

ASME-AIEE POWER CONFERENCE

September 21-23

Bellevue-Stratford Hotel
Philadelphia, Pa.

16TH NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS

October 20-21

Sherman Hotel
Chicago, Illinois
For additional information, contact Leroy A. Wickstrom, Illinois Institute of Technology, Chicago 16, Illinois

ASTME WESTERN TOOL SHOW & MEETING

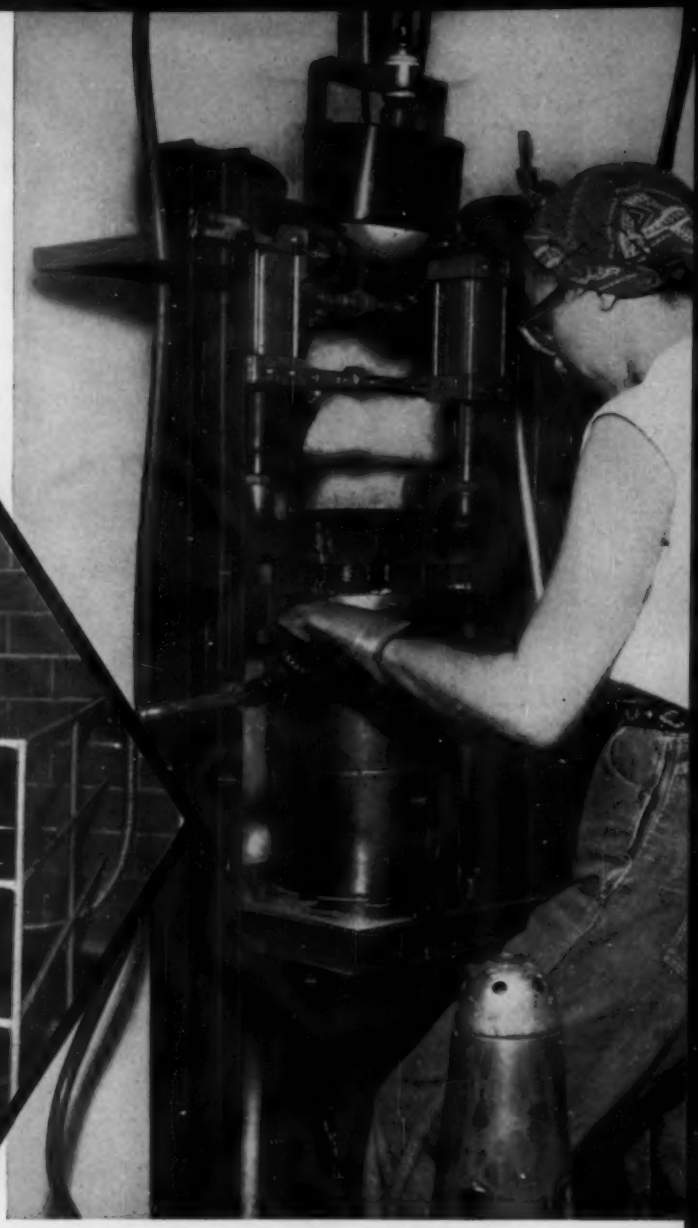
November 14-18

Los Angeles Memorial Sports Arena

Circle 98 →

TEST MACHINE at a metal fabrication plant gets air from the Le Roi 100S2 shown below. Unit also supplies air for presses, automatic and manual welders, painting machines, and automatic assembly machines.

puts your plant air supply right where you need it!



LE ROI 100-HP STATIONARY COMPRESSOR

Trouble-free air-cooled LeRoi 100S2 delivers 450 cfm of air at 125 psi — yet takes up only 20 sq. ft. of floor space.

Any way you look at it, the Le Roi 100S2 two-stage stationary compressor is your best bet to lower your cost of compressed air.

It provides cool, clean airpower. And its compactness permits installation *near the point of use,* thus eliminating excess piping and costly waste of air. If you need more air, you just install more Le Roi S2 compressors — and you can still beat the cost of centralized air systems.

The electric-motor-driven 100S2 is easy to operate and maintain. Its Dual-Control permits either constant-speed or automatic start-and-stop operation. Air cooling eliminates plumbing and water line freeze-ups . . . permits indoor or outdoor installation. Balanced design reduces vibration and noise . . . extends compressor and motor life.

Put your compressed air system on a paying basis. Investigate the complete Le Roi line of unit-type and stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin. SC-05

LE ROI STATIONARY COMPRESSORS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

ANNOUNCING A NEW CORPORATE NAME

for The Garlock Packing Company

Garlock Inc. becomes the new name for The Garlock Packing Company, Palmyra, N. Y., to reflect more accurately its broad diversification of products and markets.

Originally established to manufacture mechanical packings, Garlock now produces over 2,000 different styles of packings, gaskets, seals, molded and extruded rubber and plastic products for every major industry.

The new corporate name, Garlock Inc., more closely identifies this 73-year-old company with the growth and development of its product lines. *Today, industry goes to Garlock for such widely diversified products as:*

- Hydraulic-Pneumatic Packings
- Oil and Grease Seals
- Gasketing and Expansion Joints
- Braided Packings
- Molded and Extruded Rubber Parts
- Plastic Stock Shapes and Fabricated Parts
- Mechanical Seals for Rotating Shafts
- Metal Packings
- Leather Packings
- Electronic Components
- Dry Bearing Materials
- Fluorocarbon Tank Linings
- Missile and Rocket Components

To help you in selecting or applying these products, Garlock offers the services of over 126 thoroughly-trained sales engineers, 175 electronic component manufacturers' representatives, 180 authorized bearing distributors and 69 foreign distributors. Conveniently located warehouses and stocking points assure Garlock customers of prompt delivery.

At Garlock Inc., design and development of new or improved products and materials is an ever-present objective. To this end Garlock maintains extensive research and laboratory-test facilities. In addition, Garlock engineers and chemists are always ready to work with you in seeking solutions to tough application problems.

GARLOCK

To find out more about "the new Garlock," call the nearest of our 26 sales offices, or write to Garlock Inc., Palmyra, N. Y. *To assure prompt attention,* please refer to *Garlock Inc.* on all future correspondence and orders.

Canadian Div.: Garlock of Canada Ltd.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Circle **67** on Time-Saver Card

Hydraulic-Pneumatic Packings

Expansion Joints

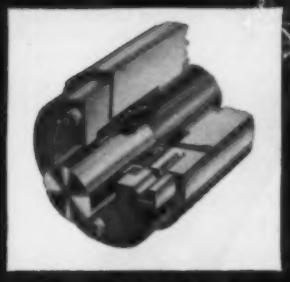
Molded and Extruded Rubber Parts

Plastic Stock Shapes and Fabricated Parts

Braided Packings

Fluorocarbon Tank Linings

Oil and Grease Seals

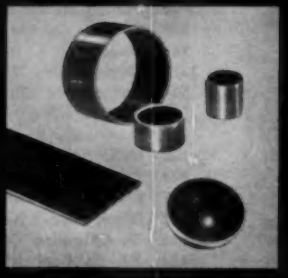


Mechanical Shaft Seals

Gasketing

Spiral Wound Gaskets

Metal Packings



Dry Bearing Material

INC.

Missile and Rocket Components

Leather Packings

Electronic Components

...Along the aisles

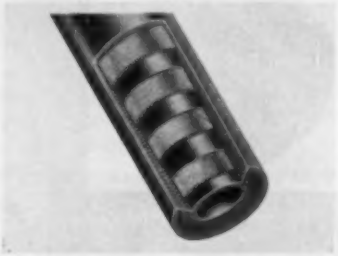
DESIGN ENGINEERING SHOW MAY 23-26 NEW YORK

Booth	
2216	AGA Div., Elastic Stop Nut Corp. of America
427	Acro Div., Robertshaw-Fulton Controls Co.
1809	Aeroquip Corp.
1134	Air-Maze Corp.
732	Alemite Div., Stewart-Warner Corp.
1009	American Sealants Co.
1505	Auburn Mfg. Co.
1438	Automatic Switch Co.
1635	Benton Harbor Engineering Works, Inc.
829	Binks Mfg. Co.
2100	Burling Instrument Co., Inc.
1537	Century Electric Co.
241	Chemiquip Co.
2318	Chicago-Allis Mfg. Corp.
504	Commercial Filters Corp.
512	Crane Packing Co.
921	Crawford Fitting Co.
122	Cuno Engineering Corp.
833	De Laval Steam Turbine Co.
219	Disogrin Industries, Inc.
1206	Dixon Corp.
1915	Dow Corning Corp.
1421	E.I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
1337	Eaton Mfg. Co.
2421	Flexonics Corp.
2206	Garlock Packing Co.
925	Gast Mfg. Corp.
1608	General Controls Co.
1724	General Electric Co.
336	Greene, Tweed & Co.
628	Hansen Mfg. Co.
1905	Hilliard Corp.
1536	Hoke, Inc.
1207	E. F. Houghton & Co.
1606	Imperial Brass Mfg. Co.
1309	International Packings Corp.
1823	I. & I. Mfg. Co.
1500	Lehigh Chemical Co.

Booth	
1630	Leiman Bros., Inc.
1504	Lovejoy Flexible Coupling Co.
1401	Mead Specialties Co.
1202	Micro Switch, Div. Minneapolis-Honeywell Regulator Co.
918	C. A. Norgen Co.
1339	Parker-Hannifin Corp.
1513	Polymer Corp. of Penna.
2436	Ramsey Corp., Subs. Thompson Products, Inc.
1810	Raybestos-Manhattan, Inc.
2023	Reliance Electric & Engineering Co.
2131	Republic Steel Corp.
935	Roper Hydraulics, Inc.
2419	Rotherm Engineering Co., Inc.
2215	Sanders Assoc., Inc.
1831	A. Schrader's Son, Div. Scovill Mfg. Co., Inc.
1340	Sealol Corp.
1813	Skinner Electric Valve Div., Skinner Chuck Co.
835	Snap-Tite, Inc.
2124	Standard Pressed Steel Co.
1300	Stratoflex, Inc.
2020	Superior Tube Co.
104	Synflex Products Div., Samuel Moore & Co.
1600	Thomas Flexible Coupling Co.
2115	Thomson Industries, Inc.
408	Titeflex, Inc.
1408	Union Carbide Corp.
1704	U.S. Electrical Motors, Inc.
1213	Vulcor Engineering Corp.
1725	Vickers, Inc., Div. Sperry Rand Corp.
2016	Waldes Kohinoor, Inc., Truarc Retaining Rings Div.
1601	Weatherhead Co., Ft. Wayne Div.
316	Worthington Corp.
2213	Wooster Div., Borg-Warner Corp.

1809 Aeroquip Corp.

You'll see . . . Spiral Wrap Hose 2755 (shown). Uses segmented fittings. Assembles in seconds with one tool. Hose of Teflon 678 is for 6000-psi pneumatics. Has 24,000-psi burst pressure. For reinforcement, spirally-wound stainless



steel wire overlays stainless inner braid. In -6, (3/8") and -8, (1 1/2") sizes. Lighter hose 675 also has Teflon tube. For 3500 psi. In -4, (1/4") to -12 (3/4") sizes. You'll see truck air brake hose. Power Steering Kit 5190 has coil of 2555 power steering hose and reusable fittings. Instructions on inside cover. Parts identified. You'll see the new catalog, which covers entire industrial product line.

Circle **200** on Time-Saver Card

1134 Air-Maze Corp.

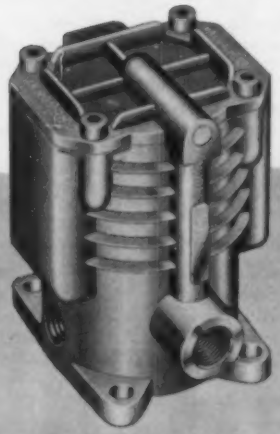
You'll see . . . Type IB air filter. Two layers of aluminum screen cloth sandwich layers of highly-inert, bonded fiber. Cylinder ends are imbedded in plastic material which forms gasket between element and retaining hardware. 98% efficient with 5-micron par-

Continued on page 52

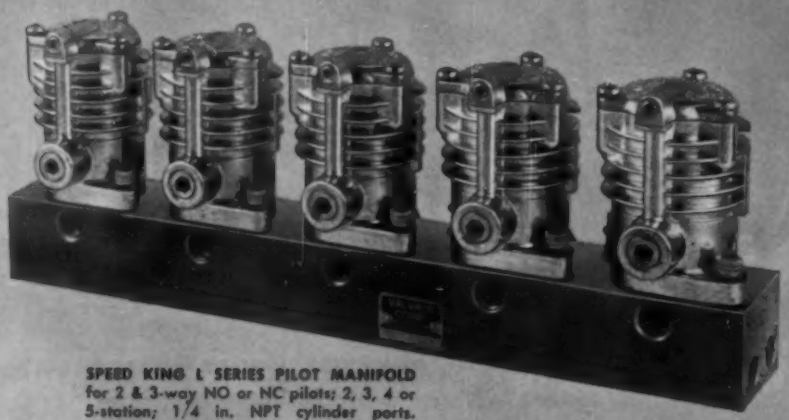
for dependable, economical control, specify versatile...

SPEED KING®

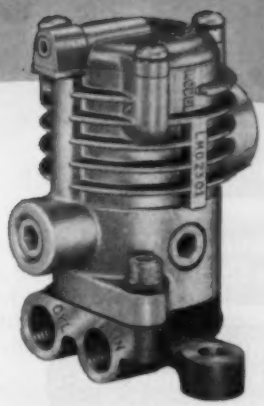
SOLENOID PILOTS



SPEED KING P SERIES PILOT 2 & 3-way NO & NC, 4-way; foot, sub-base or manifold mounting; 1/8 or 3/16 in. orifices. Foot mounting shown.



SPEED KING L SERIES PILOT MANIFOLD for 2 & 3-way NO or NC pilots; 2, 3, 4 or 5-station; 1/4 in. NPT cylinder ports. 5-station shown.



SPEED KING L SERIES PILOT 2 & 3-way NO & NC; foot, sub-base or manifold mounting; 1/16 to 1/8 in. orifices. Sub-base mounting shown.

Compact Valvair® SPEED KING pilots are ideal for control of small air or vacuum-operated devices including cylinders up to 3 in. bore, as well as for piloting larger valves. Featuring Valvair's flow-thru cooling design, they offer multi-million cycle dependability, with solenoid coils guaranteed against burn-out for the life of the valve. Choose from a full range of types, mounting styles and sizes; integral junction boxes (L Series only) and manual over-ride optional; coils for ac or dc, any voltage.

Solve your small unit control problems with SPEED KING solenoid pilots. Your Valvair or Bellows Field Engineer can recommend a size and type exactly suited to your requirements.

Bellows-Valvair

The Bellows Co. • Valvair Corp. Akron 9, Ohio

DIVISIONS OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

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Now Rotary Torque Actuation, fully cushioned!

The
CARTER
ROTARY TORQUE ACTUATOR

Patents Pending

Explore the cost reduction you can get with safe, low-cost, Carter Rotary Torque Actuators—Now with built-in cushions for longer, more dependable performance.

- No by-pass leakage
- Built-in cushions
- Rotation to 370° as standard
- Positive locking, no back-off under tension or power failure
- Complete range of sizes

Proven in thousands of applications during the past 4 years!

The Carter Rotary Torque Actuator has opened unlimited new possibilities in design and cost reduction. Transfer mechanisms, indexing, positioning, cam actions, valve operation, and many other applications become more effective and economical.

Here is safe, powerful, Rotary Torque. Actuated by air, oil, water or gas. Patented seal assures leakproof performance. Internal helical design prevents back-off under reverse tension, shock, vibration or complete power failure.

Available in 4, 5, 6, 8, 10 and 12" diameters. Special sizes and rotation requirements are available. Ask your Carter representative or write for all the details!

Complete power package units available

SEND FOR NEW BULLETIN

Bulletin R.A. 500 gives complete details and specifications on the Carter Rotary Torque Actuators. Every engineer and designer should have a copy. Send for yours today!

CARTER

CONTROLS, INCORPORATED

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Circle **34** on Time-Saver Card

...Along the aisles

ticles; nearly 100% efficient with 20-micron particles. Pressure loss is 0.3" to 0.4" water. For continuous operation at 250 F; intermittent at 300 F. Wash easily with water. Soft, flexible material doesn't crack. No deterioration from age or handling. Collecting efficiency doesn't depend upon air velocity.

Circle **201** on Time-Saver Card

1009 American Sealants Co.

You'll see . . . Loctite sealant. Liquid plastic needs no mixing, has unlimited pot life. Drop applied to dry threaded connection penetrates by capillary action. Hardens only in joint. Resists gases and all hydraulic fluids. No solid particles. Makes flare fittings vibration proof.

Circle **202** on Time-Saver Card

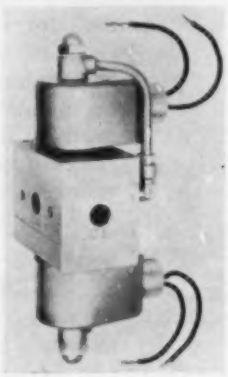
1505 Auburn Mfg. Co.

You'll see . . . seals, shims, gaskets, and rings of over 200 materials. Alu-Flex H.T. gasket material for -65 to 500 F. Silicone rubber with aluminum mesh. .016" and .020" thicknesses. Electrical properties provide conductive material between two surfaces. Restricts or filters any induced radio frequency. Positive air and liquid sealing.

Circle **203** on Time-Saver Card

1438 Automatic Switch Co.

You'll see . . . 3-position, 4-way, dual-solenoid valves. Closed-center valves



have two moving pilot cores, four flexing diaphragms. No spools, no closely-fitted parts. No sliding glands, stuffing boxes, stroke settings, or seat regrinding. Brass bar stock. Poppet-type seats. With ¼" or ⅜" pipe connections. Lock cylinder at any point in stroke. For air, water, oil from 10 to 250 psi. AC or DC. You'll see 2-way, general-purpose

Continued on page 54

Circle **155** →

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

For emergency needs call collect
MAnhasset 7-1800

ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

THOMSON INDUSTRIES Inc.
Dept. C-4, Manhasset, New York

PARTS HARDENED to 60 C...
increase life...reduce cost!

YOUR DESIGN PROBLEMS NEED

specialists

BHEW engineers are trained specialists who can save you time and money. BHEW products are noted for their dependable performance, long life and easy maintenance. Next time you have design and application problems, discuss them with BHEW—you'll profit more ways than one!

BHEW's single-acting General Purpose Cylinders (1500 psi Piston Style Series) are designed around standard components but custom-built to suit your application. They're available in a variety of mountings (pin eye is standard) with adjustable or non-adjustable rod ends, with or without rod ends.

DISCUSS YOUR DESIGN AND APPLICATION PROBLEMS WITH US!

WRITE TODAY for free Hydraulic Cylinder Engineering Reference data. 78 dimensional basic designs for general purpose and special double- and single-acting cylinders. SAVE TIME!

BH EW

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

BENTON HARBOR ENGINEERING WORKS, INC.

622 Langley Avenue • St. Joseph, Michigan

Circle **26** on Time-Saver Card

...Along the aisles

solenoid valves. 1" pipe connections. NO or NC. 3-way Quick Exhaust solenoid valves have ¼"-diameter exhaust orifices as integral part of body. No need for separate quick-bleed valve in circuit to speed up exhaust cycle.

Circle **204** on Time-Saver Card

1635 Benton Harbor Engineering Works, Inc.

You'll see . . . hollow rod hydraulic cylinder. No line connection to barrel. For boom extenders and out-riggers. Two-piece, tubular rods allow flow through two channels in rod, to operate double-acting cylinders. Rod is stationary, barrel reciprocates. You'll see double-acting cylinder (shown). Dual pilot check valve locks piston in any position when directional control valve is in neutral. Used when drift is undesirable. Has speed control.

Circle **205** on Time-Saver Card

1537 Century Electric Co.

You'll see . . . right-angle, single-reduction, 48 Frame gearmotor. Worm gear of silicon bronze. Worm of hardened, high-grade steel. High-speed shaft has face-type seal with spring back. Lip-type seal on low-speed shaft keeps gear oil from getting into motor. Gearhead has four positions. Worm gear dips into oil for continuous lubrication.

Circle **206** on Time-Saver Card

504 Commercial Filters Corp.

You'll see . . . CFC porous ceramic filter element (shown). Shapes include discs,

cylinders (10", 20", 30" long x 2½" OD), sheets, and cups. Uniform structure. Ratings of 1, 5, 10, 25, 50, and 100 microns. Resists heat shock. Withstand differential pressures to 600 psig. Honan-Crane hydraulic cartridges of adsorptive fuller's earth, cellulose, and

Continued on page 56

ADEL...offers you *single source* responsibility

for precision hydraulic control valves

4-WAY SELECTOR VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING REQUIREMENTS

a complete line for every application

GENERAL SPECIFICATIONS

FLUID: Oil, for hydraulic use only.
PRESSURE: 1500 psi maximum.
FLOW: 3 to 28 gpm.
PORT SIZES: ¼ to 1" pipe size.
MATERIAL: Slides and spools—hardened steel; bodies—gray iron castings.
Various forms of return springs or detents for slide positioning.

MODELS

Lever-Operated For Hand Control. Stem-Operated For Remote Manual Control.

Solenoid-Operated in Various DC and AC Voltages.

Pilot-Operated For Remote Hydraulic Control.

rugged simplicity for efficient, long, reliable service life

These compact, 4-way selector valves are used for control of double acting, or single acting cylinders. Simple spool-type construction provides a wide variety of porting arrangements for either open-center or closed-center hydraulic systems.

The Valves With Maximum Operating Efficiency Over The Years
***Let ADEL be your* single-source *for* precision hydraulic equipment**
Write for valve brochure containing complete specifications.

NEW DIMENSIONS IN reliability

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INDUSTRIAL & MARINE
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DISTRIBUTORS IN PRINCIPAL CITIES
THROUGHOUT THE U. S. AND CANADA

AIR He N_2

COMPRESSION to 12,000 psi

...discharge capacities to 150 scfm

with

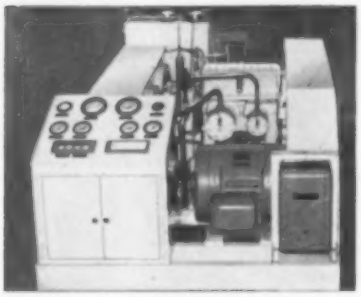
CARDAIR CENTRAL COMPRESSION SYSTEMS

New Technical Data and Catalog. See offer below.

Cardair Central Compression Systems (completely packaged, semi-portable)—are today handling air and a variety of gases—helium, nitrogen, argon, etc.—at pressures ranging from 4,000 to 12,000 psi with discharge capacities from 50 to 150 scfm. Even hydrogen is being safely compressed to elevated pressures.

Systems can be provided from stock with *guaranteed* purification of delivered gas to —100°F. dew point and less than 4 ppm oil content. Specially engineered systems to meet your particular requirements can be supplied from standard components.

This ability to control hard-to-handle gases, proven by years of exacting rocket and missile service, offers unlimited possibilities to industry—not only for testing and laboratory work, but also for actual production.



Model PB-CCS—*One of a wide selection of systems* 4-stage air-cooled Compression System—Pressure Range: 6,000—12,000 psig—Induction: 65 to 135 psig—Capacity: 75 scfm N_2 and Air; 70 scfm He—Guaranteed Gas Purity: —100°F. Dew Point, less than 4 ppm oil content.

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General Air Equipment
804 Hollywood Way, Burbank, Cal.

Circle **32** on Time-Saver Card

...Along the aisles

cotton. Honan-Crane multi-cartridge filter in ten models for 1 to 24 cartridges. Fulflo Honeycomb filter tubes in cotton, cellulose acetate, dynel, orlon, nylon, jute, and glass fiber. Duplex filter for liquids has operating pressure to 125 psi. Containers on manifold. Valve for alternate or parallel operation. Compressed air filter has rust-resistant baffle. Ranges to 125, 250, 450, 750, and 4000 psi. Flow rates to 800 scfm.

Circle **207** on Time-Saver Card

512 Crane Packing Co.

You'll see . . . Homogeneous V-rings for -65 F to 300 F. Pressures to 3000 psi. Fabric-reinforced V-rings for heavy-duty equipment. Synthetic polymers, reinforced with duck, asbestos, or other materials. Homogeneous U-cups for 1000 psi. Fabric-reinforced U-cup packings for 3000 psi. Low frictional qualities. Homogeneous piston cups for low pressures. Greater flexibility at sealing

lip makes them more responsive to light pressures. Fabric-reinforced cups for pressures to 1500 psi. Wiper rings of 90-durometer synthetic rubber. Stiff enough to wipe all dust or dirt from rod. Pliable enough to maintain tight fit. Teflon packings in full range of styles and sizes.

Circle **208** on Time-Saver Card

921 Crawford Fitting Co.

You'll see . . . tube fittings of Teflon. In all standard Swagelok shapes and sizes. For $\frac{1}{8}$" to 1" OD tubing. Quick-connect fitting has double-end shut off. In steel, stainless steel, and brass. No twisting or turning to connect or disconnect. For $\frac{1}{4}$" to $\frac{3}{8}$" OD tube. Buna-N O-rings. You'll see fittings of Titanium, Zirconium, Hastelloy B, and plaskon.

Circle **209** on Time-Saver Card

219 Disogrin Industries, Inc.

You'll see . . . pump stators and rotors, oil seals, U-cups, O-rings, and bellows. Included will be a four-foot-diameter U-cup seal. A tensile testing machine will simultaneously stretch a rubber O-ring and a Disogrin O-ring of comparable size.

Circle **210** on Time-Saver Card

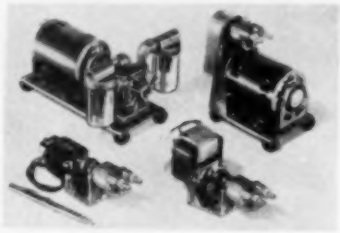
1915 Dow Corning Corp.

You'll see . . . Silastic RTV 731—a single-component fluid silicone rubber. No mixing. Cures or vulcanizes at room temperatures. No catalyst. Tensile strength is 200 psi.

Circle **211** on Time-Saver Card

925 Gast Mfg. Corp.

You'll see . . . miniature, oil-less vacuum pumps and air compressors. Two basic types in 5 rotary-vane models.



Carbon vanes lubricate themselves. Model 0330 air pumps weighs 11 oz. without motor. Choice of three motors. Series-wound motor delivers to .67 cfm. Vacuum to 20" Hg, pressure to 10 psig. Split-phase motor with belt drive and piggy-back pump mounting delivers .48 cfm. 20" Hg, 15 psig. Shaded-pole motor delivers .35 cfm Vacuum to 20" Hg, pressure to 10 psig. Model 0630 for direct drive through motor coupling. Delivers to .6 cfm. to 24" Hg, 25 psig. Choice of 1/20 or 1/12-hp split-phase motors. Model 1030 has capacity to 1 cfm. Weighs 6½ lb, including base and 1/20 hp motor.

Circle **212** on Time-Saver Card

336 Greene, Tweed & Co.

You'll see . . . the Palmetto D-W seal—a compact seal and wiper. D-ring gives positive sealing action. Double-wedge-shaped back-up rings add stability, prevent extrusion at sealing interface and D-ring heel. Rear wedge ends in wiper lip. Assembly installs into simple counterbore in cylinder head. Snap-ring holds. Eliminates conventional packing gland or groove. Saves space. You'll see hard top and bottom rings of Seal Saver compound. Fabric reinforcement. Strength equals that of phenolic laminate. Has flexibility of rubber. Hard-heeled, fabric-reinforced U-rings offer rim of reinforcing material. Prevent heels from extrusion. Have enough flexibility to snap ring over retaining lip, into packing groove of one-piece piston.

Circle **213** on Time-Saver Card

628 Hansen Mfg. Co.

You'll see . . . Series HK 2-way shut-off couplings for air, oil, and vacuum. When coupling is disconnected, torpedo valves in socket and plug seat instantly. Immediate, positive seal at both ends of line. With coupling connected,

Continued on page 58

MINIATURE FOR AIR—WATER NO. 61
LARGE CAPACITY FOR WATER—AIR—STEAM NO. 127
SMALL PRECISION FOR AIR NO. 15
HIGH CAPACITY FOR AIR NO. 18
GENERAL PURPOSE FOR AIR NO. 112
SELF CONTAINED FOR STEAM NO. 152
LOW PRESSURE FOR AIR NO. 115
GAS REGULATOR FOR LP & ACETYLENE NO. 6
LARGE VOLUME FOR WATER NO. 135
ALL PURPOSE FOR WATER NO. N26

NOW! MATCH THE PRESSURE REGULATOR TO THE JOB

LARGE ... SMALL ... FOR REGULATING AIR, STEAM, WATER, LP GAS, ACETYLENE, AND SOME OILS — Watts has the right pressure regulator to control them all precisely.

Watts pressure regulators are compact, designed for the job. No Jury-rigging needed. Nor do you have to settle for a bulky, high-priced regulator designed for an entirely different application.

And they're **sensitive**—they detect minute variations in flow rate, control them accurately with minimum pressure drop, yet offer maximum flow capacity.

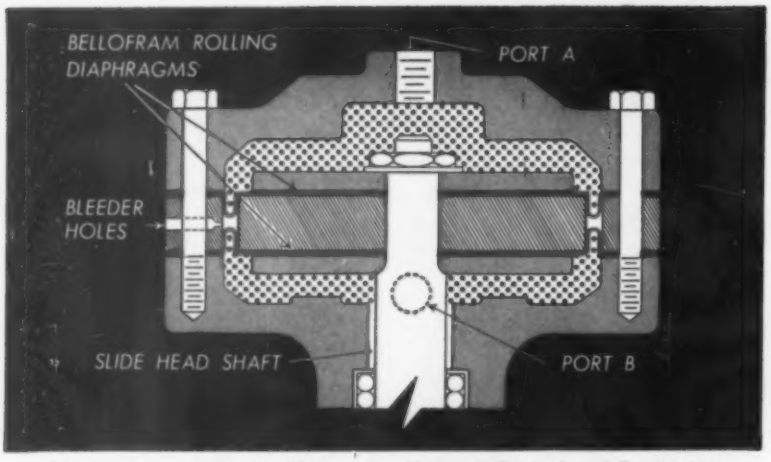
There's a complete line of regulators for air, ranging from ⅛" to 1", with or without gauges. Conveniently-located Watts distributors **ship from stock** on receipt of your order.
WRITE FOR FREE TECHNICAL CATALOG.

WATTS

FILTERS
REGULATORS
LUBRICATORS

YOUR SAFE SPECIFICATION

Watts Regulator Company, Industrial Division, Lawrence, Mass.



Air pressure entering double-acting cylinder at Ports *A* and *B* actuates slide head shaft, which controls positioning of upper electrode. Sensitive low inertia response is achieved by two frictionless Bellofram Rolling Diaphragms. Bleeder holes maintain a pressure differential.

Frictionless Rolling Diaphragms Insure Fast Follow-up for Welder

PROBLEM: To design, for use in an automatic welding machine, a pneumatic actuator for positioning the upper electrode in response to expansion or contraction of the weld nugget. Sensitive, frictionless movement was mandatory to provide instantaneous reaction to momentary changes in nugget dimensions.

SOLUTION: Federal Machine & Welder Company's designers specified a double-acting air cylinder with two Bellofram Rolling Diaphragms, each molded from a dacron fabric impregnated with a nitrile elastomer.

With no mechanical spring gradient, no break-out friction effects, and low hysteresis, these rolling, non-porous membranes instantly translate pressure changes into movement of the electrode control head. Although very sensitive to pressure variations, they are capable of sustaining high working pressures, because the force experienced on the narrow convolution is only a small fraction of the total force applied over the effective pressure area.

Operating between wide temperature ranges, these Bellofram Rolling Diaphragms provide a flex life of millions of cycles, yet do not require lubrication or close machine fits for piston and cylinder.

Bellofram Rolling Diaphragms are free positioning and friction-free. They roll off the piston sidewall and onto the cylinder sidewall in a smooth, continuous motion.

WHAT IS YOUR PROBLEM?

If conventional bellows, O-rings, cup packings, etc., fall short of your requirements, Bellofram Rolling Diaphragms may be the answer. Special types can be designed for use with almost any gas or fluid in actuators, pumps, instruments, seals, accumulators, fluid dampers, etc.

OPERATING LIMITS

Operating Pressures: 1 inch H_2O to 500 psi (up to 1200 psi in some cases).

Operating Temperatures: −85°F. to +550°F. (from −120°F. to +700°F. in some cases).

Cylinder Bore Sizes: .25 to 12 inches.

Effective Pressure Area: .028 to 108 square inches.

Total Stroke Capabilities: .01 to 12 inches.

Sidewall Thickness: .008 to .035 inches.

Send for free literature

nothing rolls like a

Bellofram®

rolling diaphragm

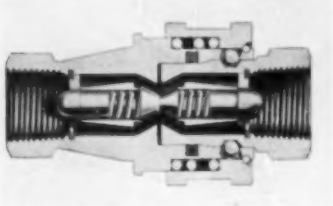
BELLOFRAM CORPORATION, 25 BLANCHARD RD., BURLINGTON, MASS.

BRowning 2-2100 Mission 3-9000 Teletype No. Burl., Mass. 166

®Reg. trademark U.S.A. and foreign countries • Bellofram Rolling Diaphragms are protected by U.S.A. and foreign patents.

...Along the aisles

free flow. O-ring in socket body compresses against inserted outside sur-



face of plug, for positive seal. In steel or brass. Connections from ⅛" to 1" FPT.

Circle **214** on Time-Saver Card

1536 Hoke, Inc.

You'll see . . . 300 Series plastic-tipped forged needle valves. Nylon or Kel-F stem tip provides tight shutoff, minimizes seat and stem-point damage from grit and overtorquing. Minimizes opening pressure surges. In ⅛" and ¼" pipe sizes, ¼" Swagelok tube size. For service to 3000 psi. Brass or 303 stainless steel bodies. Temperatures from -65 F to 400 F.

Circle **215** on Time-Saver Card

1207 E.F. Houghton & Co.

You'll see . . . synthetic packings and rod wipers for hydraulics. Seal-Guard is two, knife-edged bronze wiper rings and a rubber retaining ring. Tapered bronze rings, loaded by shock-absorbing retainer, remove foreign matter and throw it away from rod and ring. You'll see Rex-Syn packing—a compound of phenolic resin and Buna N. Low friction, high tensile strength, good resistance to abrasion and chemical attack.

Circle **216** on Time-Saver Card

1606 Imperial Brass Mfg. Co.

You'll see . . . Hytron hose. Burst pressure to 12,000 psi. Heat-stabilized polyamide inner tube. Plastic braid reinforcement. Polyamide braid covering has high resistance to abrasion, mildew, heat, sunlight, and chemicals. Lower OD:ID ratio than wire-braid rubber hose for equivalent pressures. Increased flex-fatigue resistance. Lightweight. Unlimited shelf life. Unaffected by flammable and nonflammable hydraulic fluids. Braze-Seal fittings in steel and stainless steel. Brazing ring is in sleeve. You'll see fittings for tubing of aluminum, polyethylene, and nylon. 37-deg. flare fittings in steel, stainless steel and brass. Plug, needle, diaphragm, and toggle valves.

Circle **217** on Time-Saver Card

Continued on page 62

FOR EASE OF FINISHING HYDRAULIC CYLINDERS SPECIFY

B&W *Job-Matched seamless mechanical tubing*

B&W's comprehensive quality control procedure provides . . .

• good surface finish • dimensional accuracy
• controlled uniform mechanical properties

Quality is only one of the many reasons why it pays to specify B&W Seamless Mechanical Tubing. And remember, matching tubes to jobs assures low optimum cost as well as ease of finishing. For more information call your local B&W District Sales Office or write for Bulletin TB-418. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9049-SM3

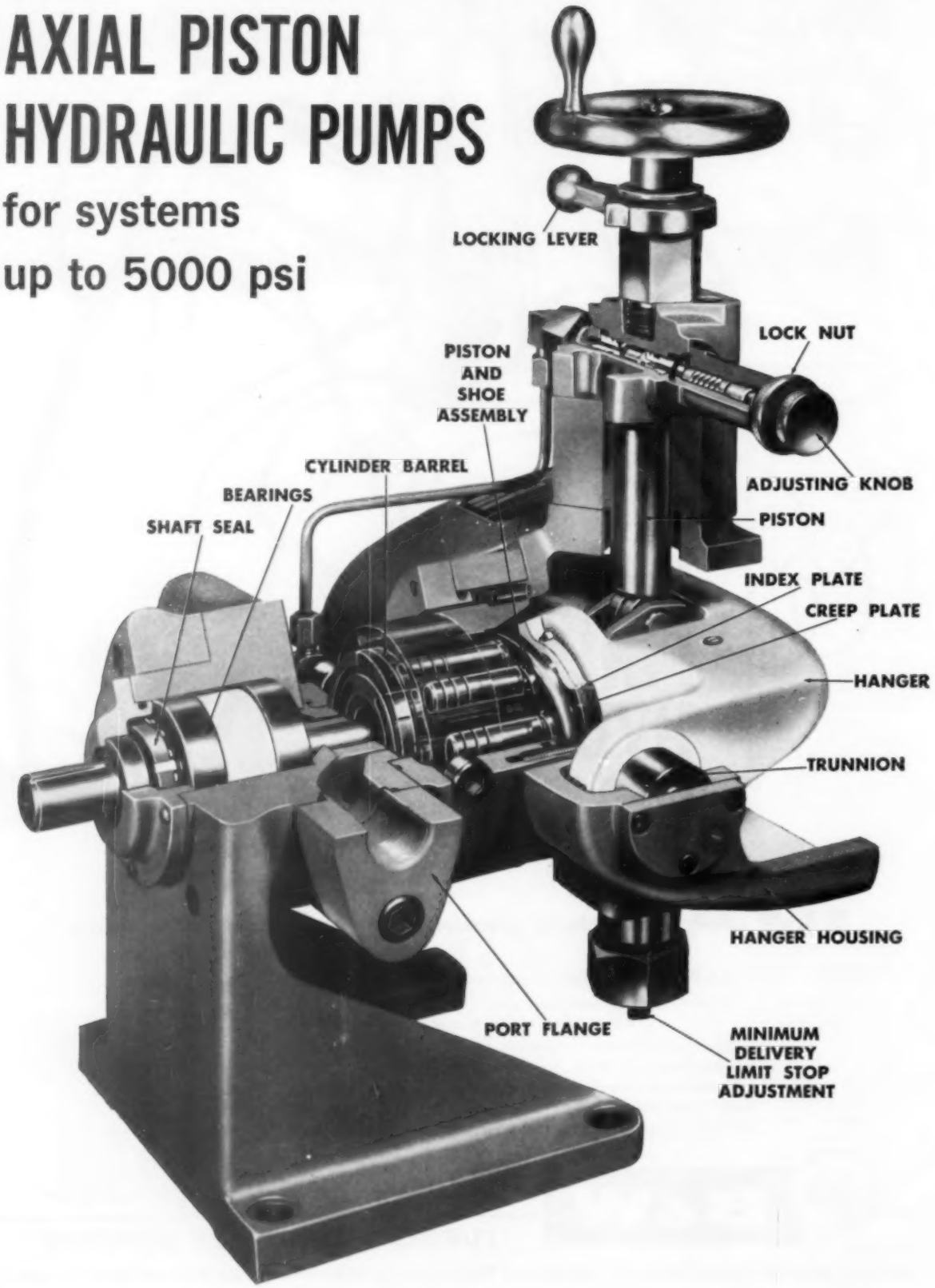
Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

Circle **179** on Time-Saver Card

Design of variable volume

AXIAL PISTON HYDRAULIC PUMPS

for systems up to 5000 psi



By: Ellis H. Born

Director of Sales-Engineering
Denison Engineering Division
American Brake Shoe Co.
Columbus, Ohio

With today's ever-increasing requirements in the transmission of higher horsepower, the designer must look to hydraulic components that will give the greatest transmission efficiency with the lowest possible cost and the smallest possible package. With smaller, lighter, more powerful equipment—operating pressures of 2000, 3000 and 5000 psi are becoming commonplace. To meet the needs of higher pressures with a high degree of reliability, axial piston pumps and motors of proper design should be considered.

For 5000 psi requirements, the axial piston pump (illustrated) is a logical choice. It operates on the principle of a series of pistons in a common barrel that progressively draw oil into the barrel on the suction stroke and force oil from the barrel into the line on the discharge stroke.

With this simple axial piston design, direct and unrestricted flow into the pumping assembly is possible, eliminating the need for the large flow areas used and the moving seals which, in turn, eliminates maintenance. Direct flow path further insures good suction characteristics —a highly desirable operating advantage for obtaining efficient hydraulic performance.

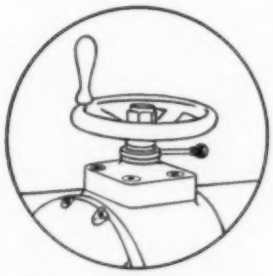
The port plate of the Denison pump is designed as an axial hydrostatic bearing which balances out the thrust of the cylinder barrel, leaving only sufficient force to create a positive seal contact between the cylinder port plate and the cylinder barrel. Because of reduced thrust, wear on mating surfaces is decreased and pump life is greatly extended at all pressures up to 5000 psi.

Where variable volume is required, it is logically desirable (for efficiency, simplicity and low maintenance) to eliminate the need for varying the position or angle of the cylinder barrel to regulate volume. In the Denison axial piston pump, output is simply regulated by varying cam plate angle. Zero to full flow or flow reversal is regulated by handwheel, hydraulic cylinder, stem, electric motor, compensator or electrohydraulically.

In the Denison design, the line of action of the combined radial load of all pistons is through the roller bearing supporting the cylinder barrel. The use of a large bearing provides non-deflecting support for these radial forces. As a result, unbalanced or twisting offset that would tend to unseat the cylinder barrel from the port plate is eliminated. A continuous, effective sealing action of the barrel against the port plate is maintained to promote high pumping efficiency.

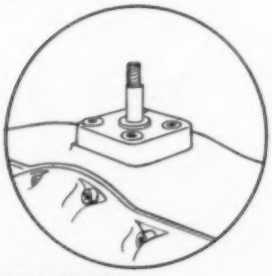
Piston and shoe assembly design also reduces by one-half the number of ball and socket couplings found in other types of axial piston pump construction. The shoes hydraulically balance out all piston thrust, eliminating need for thrust bearings.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.

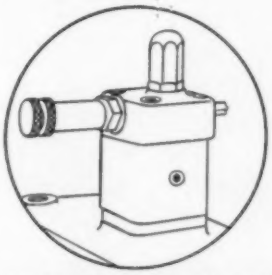


HANDWHEEL CONTROL
...with locking device for accurate manual pump volume regulation.

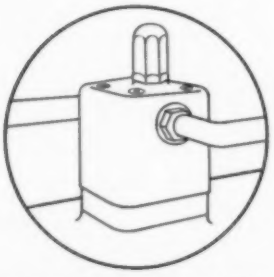
ELECTRIC MOTOR CONTROL
...adjusts pump volume to desired level. Integral brake in gear-head motor eliminates over-travel.



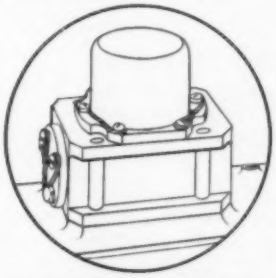
STEM CONTROL
...provides mechanical linkage to the driven equipment.



PRESSURE COMPENSATOR CONTROL
...affords automatic regulation of pump volume to meet preset pressure demands.



HYDRAULIC CYLINDER CONTROL
...similar to stem control, except volume is hydraulically regulated.



ELECTRO-HYDRAULIC CONTROL
...utilizes sensitive, system error-detecting unit which energizes hydraulic volume control piston.

NEW CATALOG FOR DESIGNERS AND ENGINEERS

Write for your copy of Bulletin 220—"Hydraulic power to 5000 psi". Includes complete specifications, operating data and applications for Denison's full line of hydraulic pumps, motors and controls.

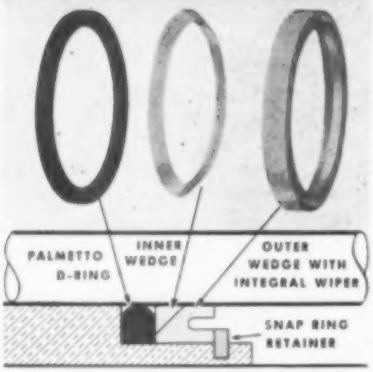
DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

Circle **52** on Time-Saver Card

Designing With the D SEAL W

PATENTS ISSUED AND APPLIED FOR

the newest advance in packing technology from PALMETTO® Engineering



• The new Palmetto D-W Seal provides a compact, low-cost seal which matches the performance of costlier, bulkier packings. Designed primarily to provide a superior seal on rods subject to reciprocating motion in hydraulic or pneumatic service.

The unique D-W Seal offers these outstanding advantages: **SHARPLY REDUCED MACHINING COSTS • LESS COST FOR PACKING • SAVING OF SPACE • POSITIVE SEAL WITHOUT EXTRUSION • INTEGRAL ROD WIPER**

HOW THE PALMETTO D-W SEALS

Palmetto D-ring, installed under slight compression, rests firmly on its square base . . . provides a positive seal under low or high pressure. Double wedge back-up rings contribute bulk and stability . . . guard the D-ring from rolling, twisting, or extruding. Self-centering action of seal assembly also adds bearing support . . . helps center the rod while under pressure. Lip on second wedge exerts dependable wiping action . . . avoids need for separate wiper element. Entire D-W seal assembly fits into counter-bore in cylinder head . . . is secured with a snap ring near cylinder head's outside surface.

Since the D-ring element is furnished in a broad range of rubber compounds, the D-W Seal operates with any fluid and at temperatures from minus 70F to 600F. The standard back-up wedge rings are made of nylon, but other plastics or metals can be supplied to meet specialized application conditions to give the D-W Seal complete versatility.

• *For more particulars, write:*

GREENE, TWEED & CO.

NORTH WALES, PA.

See us at Booth 336, Design Engineering Show New York Coliseum, May 23-26

Circle **70** on Time-Saver Card

. . . Along the aisles

1823 L & L Mfg. Co.

You'll see . . . flanged hydraulic tube and pipe fittings of welded, machined steel. O-ring seal. Quick assembly. Repeated disassembly without loss of sealing ability. Direction of angled outlets may be aligned perfectly with system piping. No danger of overtorquing and hydraulic fluid contamination inherent in pipe thread connections. Thirty models. Flared tube, dryseal pipe, weld, and solder attachment. Straight, 90-deg., and 45-deg. flow angles. Male and female. Several tees.

Circle **218** on Time-Saver Card

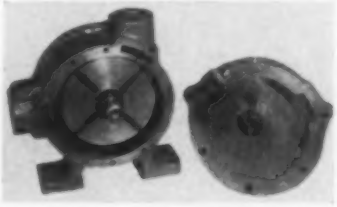
1500 Lehigh Chemical Co.

You'll see . . . Anderol L-386 hydraulic oil—a medium-viscosity, synthetic diester. Temperature range is -65 F to 350 F. Viscosity index is 206; evaporation rate, 5.1. Rust protection and antifoam. Complete compatibility. Low shear. Nongumming. You'll see synthetic lubricants, corrosion preventives, and anti-seize compounds.

Circle **219** on Time-Saver Card

1630 Leiman Bros., Inc.

You'll see . . . air motors for 200 to 1800 rpm. Deliver to 5 hp from 10 to 100 psi. Mount in any position. Variable speed.



Two models are reversible. Don't stall. Take up wear. Maximum power at high torque. Oil cup oils working parts. Muffler absorbs oil which may blow out.

Circle **220** on Time-Saver Card

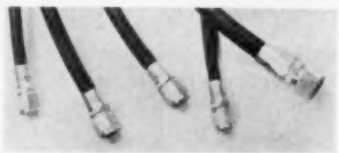
1202 Micro Switch Div.

You'll see . . . side-plunger actuator switches. Side roller plunger or plain side plunger. Models for fast and slow cams and slides. Actuator heads mount in four positions, 90 deg. apart. Rollers rotate 360 deg., lock in any position. You'll see maintained-contact yoke-actuator. When actuator moves from either extreme position, internal switching unit transfers and maintains circuit. Center-neutral, plug-in limit switch can do work of two limit switches. Can save time, space, and wiring. Can simplify actuating systems. Two, 2-circuit, double-break, basic switches control four isolated circuits. Roller-lever actuator operates one basic switch when moved left; the other, when moved right. Replaces in seconds without disturbing electrical connections. 1-way roller arm and rod actuator switches for side or bottom mounting. For machine tools which have a slide to actuate switch, override it, but not actuate it on return stroke. Field-adjustable, horizontally and vertically.

Circle **221** on Time-Saver Card

1513 Polymer Corp. of Penna.

You'll see . . . Nylaflow pressure hose. Nylon inner tube reinforced with high-tensile yarn. Has one-fifth the weight,



and less than one-half the wall thickness of rubber hose with equivalent burst strength. Cover resists abrasion. 1250-psi hose, when pressure-pulsed to 2500 psi, flexed 1,171,000 times, and withstood 96,000 impulse cycles—without failure. Unaffected by flammable and nonflammable hydraulic fluids. For -65 to 200 F continuous, to 300 F intermittent. Maximum operating pressures are 1250 and 2000 psi. Burst pressures are 5000 and 8000 psi. ID's are ⅛", 5/32", ¼", 5/16", ⅜", and ½". You'll see Nylaflow pressure tubing for hydraulic and pneumatic lines. Nylasint sintered nylon parts with built-in lubrication for bearings.

Circle **222** on Time-Saver Card

1810 Raybestos-Manhattan, Inc.

You'll see . . . R/M 1550 piston cups and R/M 1250 packing rings. Made of Teflon and asbestos cloth. Minimize thermal expansion and plastic flow of pure Teflon products. Resist extrusion. Broad chemical resistance. Low coefficient of friction without lubrication. For temperatures to 650 F. Minimal thermal expansion. Handle low and high pressures. Air or oil pressure expands circumference of ring on pressure stroke. Gland pressure doesn't cause excessive friction. Low friction at cup's sealing surface. Cup doesn't fail in tension at base.

Circle **223** on Time-Saver Card

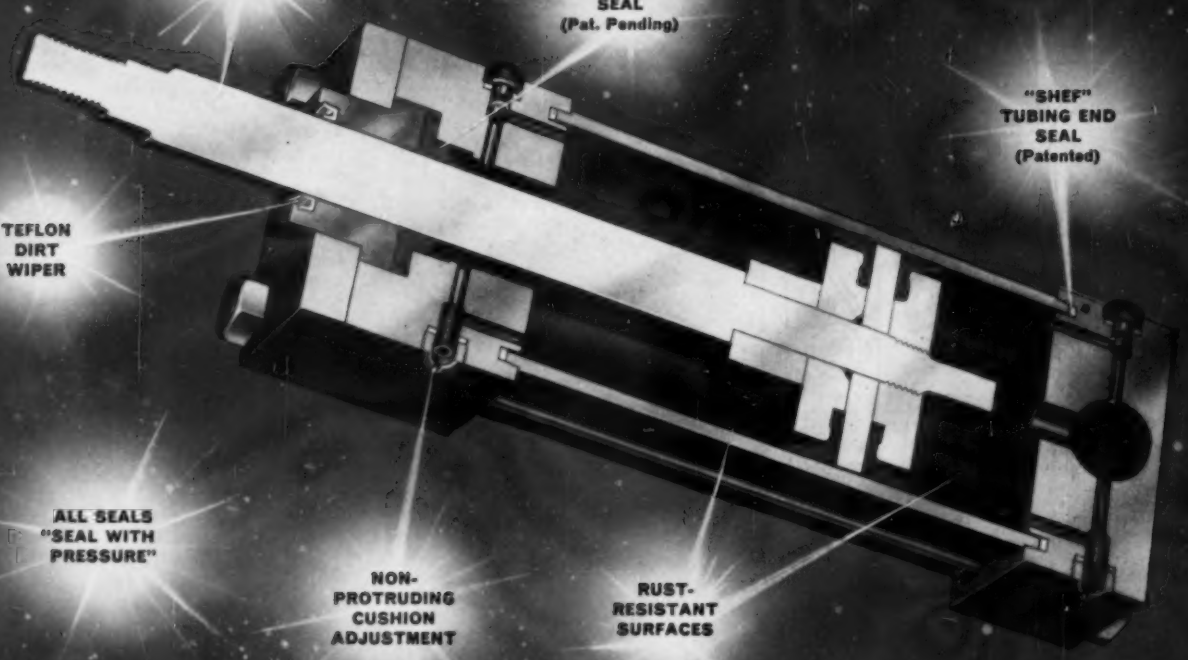
2419 Rotherm Engineering Co., Inc.

You'll see . . . Type YR revolving joints for gas and liquid. No bearings. No lubrication. Low turning torque. Rotating syphon. For temperatures from -100 F to 500 F. Used with brackets. Type AR does not require solid mount-

Continued on page 64

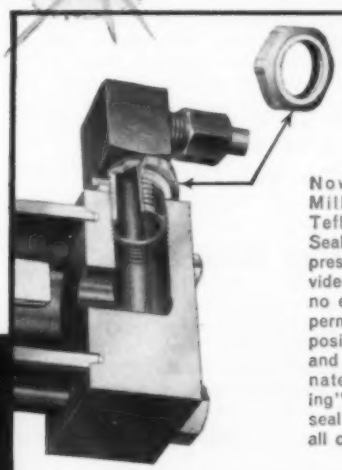
Circle **111** →

Stellar RELIABILITY and ECONOMY


CASE HARDENED CHROME-PLATED ROD
"STA-DYN" ROD FLANGE SEAL (Pat. Pending)
"SHEF" TUBING END SEAL (Patented)
TEFLON DIRT WIPER
ALL SEALS "SEAL WITH PRESSURE"
NON-PROTRUDING CUSHION ADJUSTMENT
RUST-RESISTANT SURFACES

Miller AIR CYLINDERS

PORT SEALS



Now—with every Miller Cylinder—Teflon-sealed Port Seals that "Seal with pressure" are provided as standard at no extra cost. They permit much faster positioning of lines and fittings, eliminate "overtightening" damage, and seal perfectly against all operating media.

Here are eight more reasons why Miller Air Cylinders continue to be the most economical and reliable cylinders that money can buy. These stellar features—including the new port seals—are standard Miller construction—yours at no extra cost. Thus, they provide appreciable savings in original investment—*particularly for those who insist on "J. I. C." quality throughout.* Savings in operating costs are even greater, because these features are proven assurance of longer cylinder life, greater efficiency, reduced maintenance and downtime.

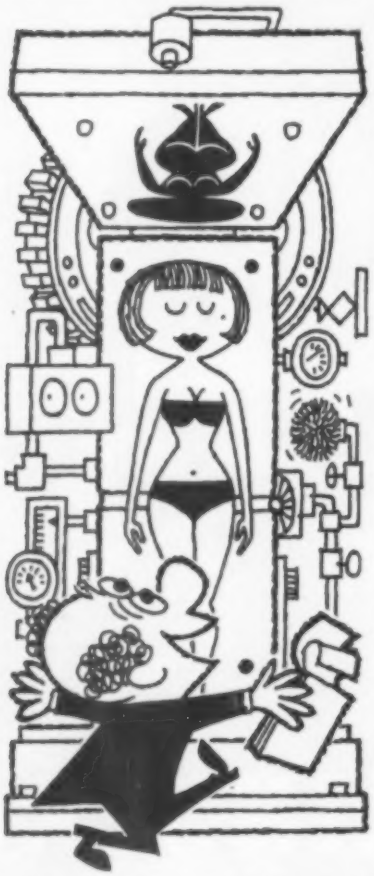
Specify "Miller" for greater reliability and economy! Write for bulletin.

MILLER FLUID POWER

7N017 YORK ROAD, BENSENVILLE, ILLINOIS

WOW

WHAT AN ASSEMBLY



THAT'S EXACTLY WHAT WE'RE INTERESTED IN! A FINE ASSEMBLY THAT IS . . . FOR THE FINEST IN CUSTOM CYLINDERS AND VALVES . . . . CALL, WE'LL TALK!!!!!!!

UNIVERSAL HYDRAULICS

DIVISION OF HOLAN CORPORATION

4500 BEIDLER ROAD
WILLOUGHBY, OHIO
WHITEHALL 2-4595

Circle **164** on Time-Saver Card

. . . Along the aisles

ing. Used with flexible hose. Type 1905 joint (shown) handles four different air or fluid pressures. One or all four passages can rotate.

Circle **224** on Time-Saver Card

935 Roper Hydraulics, Inc.

You'll see . . . Series T compact pump units. For hydraulic pressure feed and

transfer work on clean liquids. 192 models. Standard NEMA foot mountings. Install easily. Pressures to 400 psi. Capacities from 0.3 to 55 gpm.

Circle **225** on Time-Saver Card

1340 Sealol Corp.

You'll see . . . Temco Winder Drive Unit for winding paper, plastics, textiles, rubber, metal, and wire. Hydraulics controls tension. Maintains internal torque balance between hydraulic circuit and roll. Circuit compensates for varying torque caused by build-up of roll. You'll see check valves and mechanical seals.

Circle **226** on Time-Saver Card

1813 Skinner Electric Valve Div.

You'll see . . . new, A series valves for medium-sized cylinders. 3-way. NO and NC—directional control and multipurpose. Orifices are 3/32", 1/8", and 5/32". Body ports are 1/4" NPTF; sleeve ports, 1/8" NPT. Maximum operating pressure differentials to 250 psi. Completing L series are valves with 3/4" and 1" orifices and NPTF threads. NO and NC. Differentials from 5 to 150 psi. Bodies are forged naval brass. Diaphragm of nylon and Buna N layers is fully supported in both on and off positions. 3-way L series solenoid valves have 3/8", 1/2", and 3/4" orifices. NO and NC. Directional control. Standard and explosionproof. 2-way R series now has high-pressure models for differentials of 5 to 1250 psi (ac) and 5 to 1000 psi (dc). Spring-loaded plunger and piston assembly. NC. Mount in any position. Orifices and NPTF ports are 1/4". Compact V-5 series valves handle 400-psi differential. 2-way types are NC, seal in either direction. 3-way valves are NC, NO—directional control and multi-purpose. Orifices are 1/32"; NPT ports, 1/8" or 1/4".

Circle **227** on Time-Saver Card

1300 Stratoflex, Inc.

You'll see . . . self-locking nut series of cadmium-plated steel, for 550 F. CR series of silver-plated stainless steel, for 800 F. Adapts to flared or flareless sealing. One piece of metal. Needs no safety wire. Locking element confined within limited thread area. Free hand starting. Lock is fully engaged before nut seats. When fully seated, lock is retained. Reusable. Resists loosening even if unseated. Self-sealing, quick-disconnect couplings have nonmetallic seals. To disassemble, pull back knurled sleeve. This seals both ends. Then take apart. To assemble, pull back sleeve, push in male end, release sleeve. NPTF pipe thread, or SAE O-ring boss thread. Tube OD from 1/4" to 1 1/4". Pressures to 2000, 3000 psi.

Circle **228** on Time-Saver Card

104 Synflex Products Div.

You'll see . . . flexible hose for liquid and gas. 1/16"-ID hose for 3000 psi (burst pressure, 12,000 psi). Other ID's are 1/4", 1/8", 3/16", 13/32", 1/2", 5/8", 3/4", 7/8", and 1". High-strength yarn reinforces polyamide inner tube. Cover resists abrasion. One hose meets majority of needs. Weight is 1/6 that of conventional hose. For 225 F.

Circle **229** on Time-Saver Card

2115 Thomson Industries, Inc.

You'll see . . . Nyliners—nylon bearings for rotation and reciprocation. Thin liners of nylon resist abrasion, corrosion, and poundout. Compensation gap assures maintenance of diametrical tolerances. Install easily. No lubrication. Operate in liquids. Self-retaining. Low friction. No friction oxidation. Damp vibration. Operate silently. Lightweight. You'll see Ball Bushings for linear motions, and 60 Case hardened and ground steel shafts.

Circle **230** on Time-Saver Card

1704 U.S. Elecrtical Motors, Inc.

You'll see . . . Type H-7 close-coupled hydraulic pump motor. Cast iron frame resists corrosion. Mounting bracket eliminates mounting base, complicated adaptors, reduces length of pump-motor package. Normalized castings prevent warping of precision-machined

Continued on page 66

Under 100-psi pressure in desk-top Suntac demonstration, a straight mineral oil leaks out four times faster than Suntac of the same viscosity.

You can cut oil leakage as much as 75% simply by switching to a Suntac oil

Don't cuss your "problem" leaker, don't look for a bigger drip pan—try a Suntac oil.

Suntac oils, besides their exceptional lubricating qualities, have the remarkable capacity to *stay put* instead of dripping out and making floors unsafe.

Match Suntac against the oil you're now using. Notice how its non-gummy antileak characteristic can reduce your oil losses as much as three-fourths. In fact, *many users report oil savings up to 90%!*

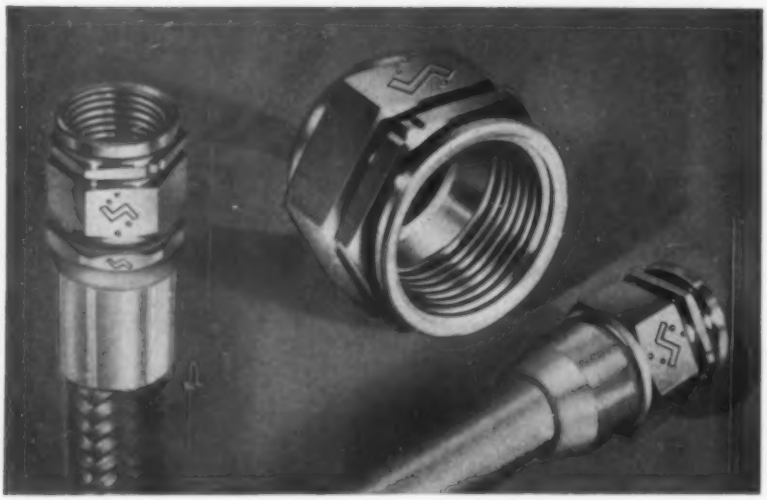
Have your Sun representative arrange for the five-minute demonstration shown above—right on your desk top. Or write for Suntac information to SUN OIL COMPANY, Phila. 3, Pa., Industrial Products Dept. AH-5, In Canada: Sun Oil Company Limited, Toronto & Montreal.

SUNOCO

MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

Circle **151** on Time-Saver Card

NOW! POSITIVE LOCKING WITHOUT THE LIMITATIONS OF WIRING DEVICES



NEW STRATOLOK

REG. APPLIED FOR

SELF-LOCKING FLUID COUPLING NUT

Eliminate time and expense involved in safety wiring. The new Stratolok* self-locking fluid coupling nut assures positive locking and trouble-free sealed joints in critical applications.

Stratoflex's new Stratolok series of self-locking nuts is based on a 3-way mechanical displacement of threads. The Stratolok locking element permits free hand starting and insures that the lock is fully engaged before the nut is completely seated. When fully seated, the lock is retained.

Stratolok nuts meet all locking performance requirements of Specification MIL-N-25027. They are available in a complete range of sizes and are reusable and completely interchangeable with existing AN and MS nuts. Stratolok "S" series nuts, for temperatures up to 550°F, are Cadmium-plated steel; "CR" Series, for temperatures up to 800°F, are silver-plated stainless steel. For complete information, write for Stratolok Bulletin S-8.

*Formerly SPS Self-Locking Nut

SF5-0

STRATOFLEX Inc.

P.O. Box 10398 Fort Worth, Texas
Branch Plants: Hawthorne, Cal., Fort Wayne, Toronto
In Canada: Stratoflex of Canada, Inc.

SALES OFFICES:
Atlanta, Chicago
Cleveland, Dayton
Detroit, Fort Wayne
Fort Worth, Hawthorne
Houston, Kansas City
Milwaukee, New York
Philadelphia, Pittsburgh
San Francisco, Seattle
Toronto, Tulsa

Circle **150** on Time-Saver Card

...Along the aisles

parts, assure concentric mounting. Rigid, precision, splined coupling for direct pump connection. Completely-enclosed housing. No exposed couplings. Single and double ends. From ¾ to 50 hp.

Circle **231** on Time-Saver Card

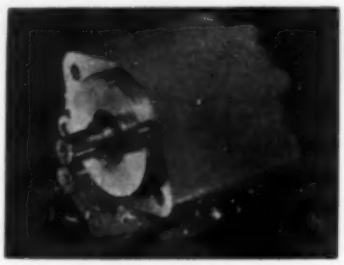
1725 Vickers, Inc.

You'll see . . . Electrohydraulic servo building-block systems. SA4 servovalve has flow rates to 37 gpm at 1000 psi. High response, good dirt tolerance. You'll see vane pumps for water-base, fire-resistant fluids, and a deceleration valve which operates precisely, regardless of system flow rate. Improved, uprated directional valves have greater flow capacity. You'll see an economy power pack, and a new line of power steering components. High- performance, high-speed mobile pumps give much greater hydraulic horsepower without increase in envelope size. Interchangeable parts. Wide range of sizes.

Circle **232** on Time-Saver Card

2213 Wooster Div.

You'll see . . . a new family of hydraulic gear pumps. Simpler design, longer life, higher performance. Outlet pressure diverted behind rear bearings, to reduce clearance between bearing faces and gears. Optimum volumetric efficiency at all speeds and pressures. Tin-aluminum-alloy bearings. Double-lip shaft seal. Hardened and ground steel gears and shafts. High-tensile aluminum bodies. Wide variety of porting, mounting, and drive arrangements. 20 standard pumps. All have either side or end porting, or a combination of these. Standard SAE mounting flanges and drive shafts. Capacities from 0.7 to 140.0 gpm at 2000 rpm, 2000 psi.



Circle **233** on Time-Saver Card

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Come and see us to discuss your fluid power developments and problems.

Logan's 41th year...

...of uninterrupted service to Industry

valves

cylinders

airline filter-lubricators

special pneumatic and hydraulic machines

providing you with maximum performance and dependability in fluid power equipment

Logan... *world's largest manufacturers of air and hydraulic equipment*

OVER 11,000 STANDARD CATALOGED ITEMS; 11 CATALOGED LINES OF AIR AND HYDRAULIC CYLINDERS

FREE...
Send for your copy of
A down-to-earth 20-page booklet on the "rights" and "wrongs" in setting up and servicing air and hydraulic equipment.

Member:
National Machine Tool Builders' Assn.
National Fluid Power Assn.

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LOGANSPORT MACHINE CO., INC., 832 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 Air Cylinders
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- ☐ 100-3 Air-Draulic Cyls.
- ☐ 100-4 Air Valves
- ☐ 100-5 Logansquare Cylinders
- ☐ 100-6 Ultramation Cylinders
- ☐ 300-2 Presses
- ☐ Facts of Life
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- ☐ 200-3 750 Series Hyd. Cyls.
- ☐ 200-4 and 200-7 Hyd. Valves
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Circle **102** on Time-Saver Card

All Marine and Military Specification "O" RINGS ready for immediate shipment

All Sizes and Quantities of Viton, Butyl, Teflon and Silicone Now in Stock.

A tremendous inventory of all Military Spec as well as standard quality "O" Rings is now carried by Bearings, Inc. in order that we may be able to meet all customer requirements without delay.

Prices are competitive with other sources and with our automatic packaging equipment we can package to Military Specifications or individual requirements. We can also supply "O" Rings as "cure-date" kits. Inquiries for your immediate needs or for a year's requirements will be answered promptly. Write or call NOW!

Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Painesville • Toledo • Youngstown Zanesville • **INDIANA:** Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York **WEST VIRGINIA:** Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden • Newark **NEW YORK:** Balanrol Corp., Buffalo • Niagara Falls • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

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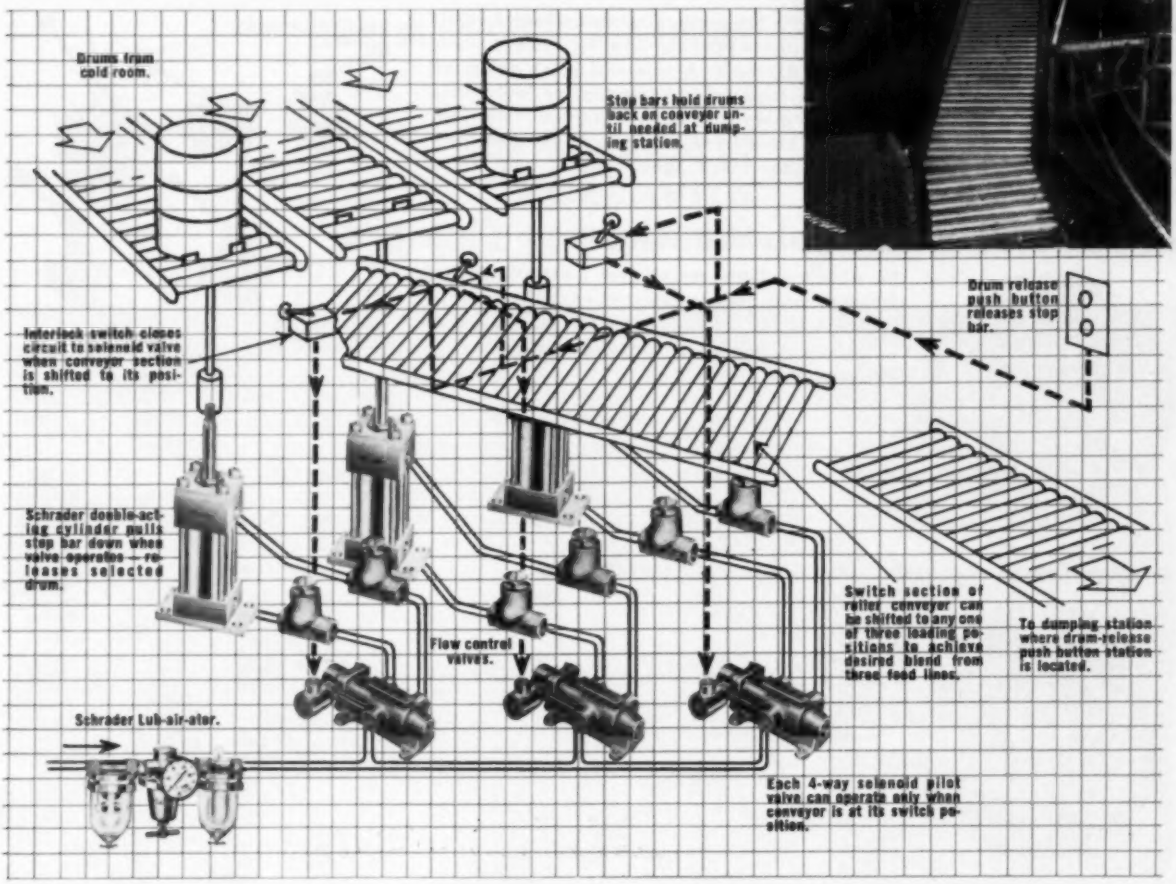
Circle **24** on Time-Saver Card

Processors automate even heavy work with air. In a complex frozen juice concentrate blending operation, Plymouth Citrus Products Cooperative, Plymouth, Fla., hooks up Schrader Air Products simply and economically to a gravity conveyor. Full 55-gal. barrels on feed sections roll down to stop bars and are selected in correct order and ratio for dumping. "The Schrader system performs well," says C. Byron Smith, plant manager. "We're handling 200 to 300 barrels a day on this selective conveyer, and could handle more."


Drums from cold room.
Stop bars hold drums back on conveyor until needed at dumping station.
Drum release push button releases stop bar.
Interlock switch closes circuit to solenoid valve when conveyor section is shifted to its position.
Schrader double-acting cylinder pulls stop bar down when valve operates — releases selected drum.
Flow control valves.
Switch section of roller conveyor can be shifted to any one of three loading positions to achieve desired blend from three feed lines.
To dumping station where drum-release push button station is located.
Schrader Lub-air-ator.
Each 4-way solenoid pilot valve can operate only when conveyor is at its switch position.

PROCESSOR AUTOMATES BACK-BREAKING CHORE WITH SCHRADER AIR PRODUCTS . . . GAINS SPEED, EFFICIENCY, BIG ECONOMIES

Solve difficult problems of handling, conveying and sorting, just like this company . . . with air! Versatile Schrader Air Products take punishing environments in stride, even corrosive atmospheres . . . Work together like magic on American production systems of many different kinds in hundreds of industries.

You already have air. Add Schrader Air Products to push, pull, hold, position, move work repetitively . . . cure headaches of weight, assembly, production maintenance . . . perform tirelessly and with precision. Speedy yet safe Schrader takes the drudge out of work, adopts to special needs, saves time, money and effort.

Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data write:

Schrader
a division of SCOVILL

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Division of Scovill Manufacturing Company, Incorporated
456 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

Circle **143** on Time-Saver Card

BARKSDALE AIR-SEAL* VALVES

LOW PRESSURE AIR TO 250 P.S.I.

. . . over 200 different valves available.

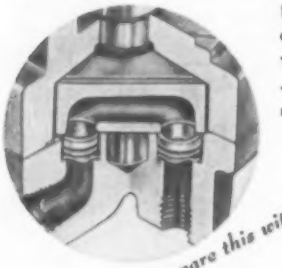
The air pressure is the sealing force . . . the higher the pressure, the tighter the seal.

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

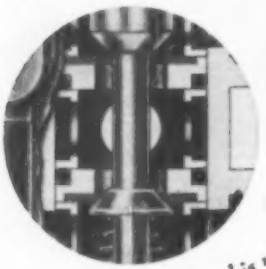
Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

compare this with conventional SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion — non-corrosive materials throughout.

No coil burnout — heat dissipating "integral" design.

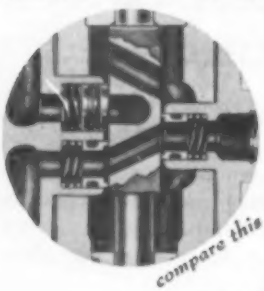
compare this with conventional SPOOL VALVES

Slower response due to long spool travel.

Leakage increases with use — dirt and corrosion particles are ground-in between spool and seals—Sticking!

Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



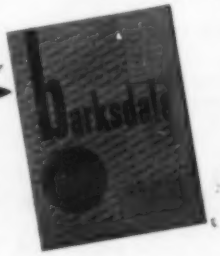
Leakproof for years of service — self-adjusting to wear.

No coil burnout — because valve does not freeze up.

compare this with conventional SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV



CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

MANUALLY OPERATED

4-Way valves ¼ to 1½" N.P.T. with or without spring return

Shut-off valves ¼ to 1" N.P.T. with or without spring return

FOOT OPERATED

4-Way valves ¼, ⅜ and ½" N.P.T. with or without spring return

SOLENOID-PILOT

4-Way valves ⅛ to ¾" N.P.T. A.C. and D.C. Standard

Explosion-proof

J.I.C. type

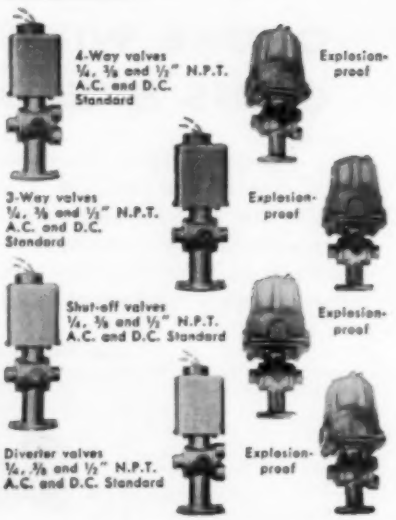
With manual override

3-Way valves ¼ to ¾" N.P.T. A.C. and D.C. Standard

With manual override

Explosion-proof

DIRECT-SOLENOID



4-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

3-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

Shut-off valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

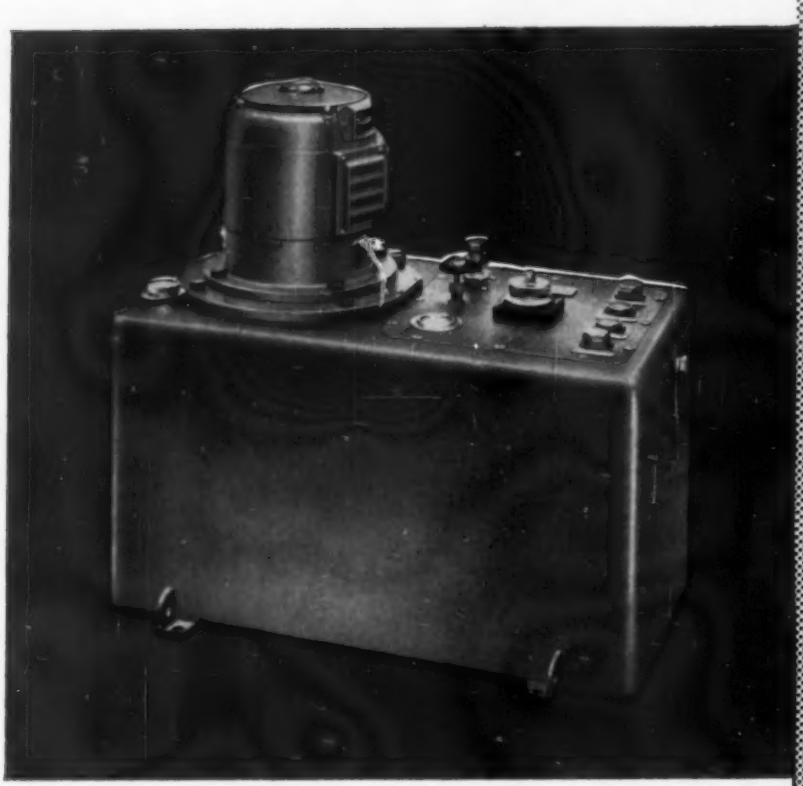
Diverter valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

PACKAGED POWER
IN ITS NEATEST FORM

the 'M' range of KEELAVITE hydraulic power-packs

Only standard Keelavite Units used.



THE 'MIDGET'

7½ Gallon Tank
Electric Motor up to 2 h.p.

THE 'MINOR'

20 Gallon Tank
Electric Motor up to 5 h.p.

THE 'MAJOR'

50 Gallon Tank
Electric Motor up to 12½ h.p.

THE 'MIGHTY'

75 Gallon Tank
Electric Motor up to 25 h.p.

Pump capacities and controls to suit customers' requirements

We at Keelavite are a team of experts engaged SOLELY in the application of hydraulic power

KEELAVITE

KEELAVITE HYDRAULICS LTD, ALLESLEY, COVENTRY, WARWICKSHIRE

Telephone: Meriden 441

Cogent

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

FLOW CONTROL VALVES . . . are pressure-compensated

Designation: Series 8600

Features: For meter-in, meter-out or bleed-off circuits. Knife-edge orifice. Need no drain connection. Use

as 2 and 3-port models. Vernier knob has provision for safety-lock wiring. Available with return free-flow check.

Specifications: For 3000 psi. ¼"-⅜" pipe tap has capacity of 6 gpm; ⅜"-½" pipe tap has capacity of 16 gpm; ¾"-1" pipe tap, 30 gpm; 1¼"-1½" pipe tap, 125 gpm.

Rivett, Inc.
Boston, Mass.

Circle **300** on Time-Saver Card

HYDRAULIC PUMP/MOTORS . . . for continuous duty

Features: Pump's splined shaft directly connected to internally—

splined motor shaft. Eliminates flexible couplings, pump mounting platforms. Less mounting area, perfect alignment. Motor couples directly to all types of aircraft hydraulic pumps. With bell housing, couples directly to flange-mounted pumps with keyway shaft. With double-end mounting, drives two pumps. High starting torque. Smooth-running little vibration. Dripproof.

Specifications: ¾"-25 hp.

Palley's
Los Angeles, Calif.

Circle **301** on Time-Saver Card

COMPRESSED AIR DRYERS . . . have large capacities

Features: Automatic—need no regeneration, heat, or power. Intercept water vapor and microscopic

abrasives which elude aftercooler, receiver, and filters.

Specifications: In 33 sizes. New sizes have capacities of 10,000, 11,000, and 11,500 cfm at 100 psi.

Van Products Co.
Erie, Pa.

Circle **302** on Time-Saver Card

MINIATURE CYLINDERS . . . have U-cup packings

Designation: Para-Mite

Features: Packings have minimum friction. Honed steel barrel. Little adhesion between packings and metal. Heads permanently attached to barrel—no tie rods. Bronze rod head has good bearing qualities. Hard-chrome-plated rods. Single-rod double-acting; double-rod, double-acting; spring-return.

Specifications: Bores ¾", 1", 1-3/16". For air to 250 psi, oil to 750 psi.

Paragon Mfg. Corp.
Cleveland, Ohio

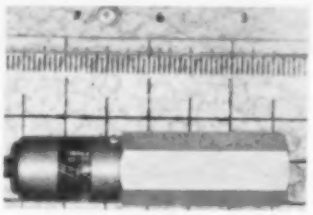
Circle **303** on Time-Saver Card

MINIATURE PRESSURE SWITCH . . . is piston operated

Designation: Models 760-A, 760-B.

Features: One moving part. Fixed differential. For any medium. In steel or aluminum, Cadmium or anodized finish. Operates in any position.

Specifications: Adjustable operating pressure: Model 760-A, to 250 psi; Model 760-B, 200-1000 psi.

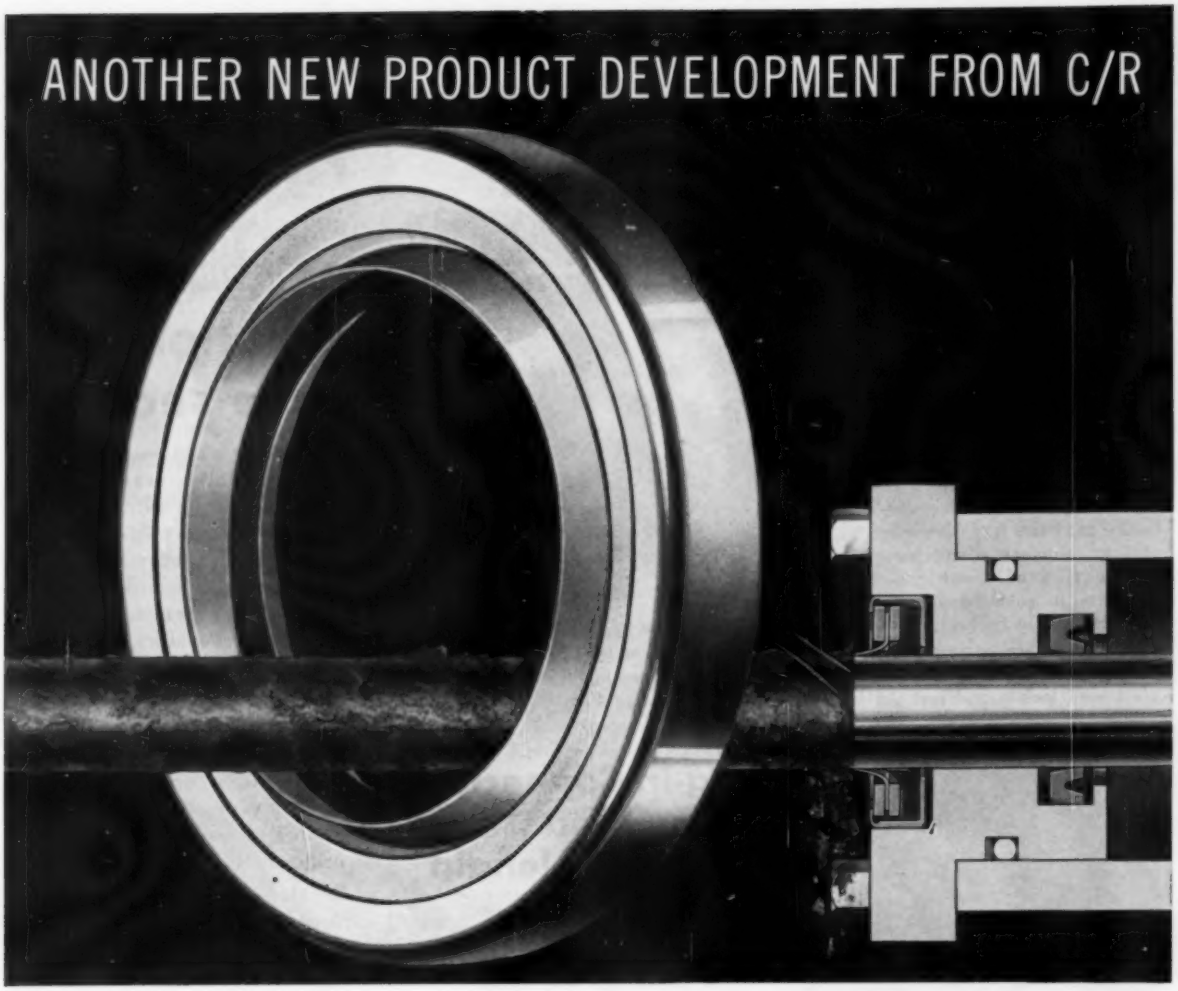


Proof pressure 5000 psi. Envelope is .75" hex x 3.12". ¼" NPT port. U.L. approved switch 5 amp, 240 v, spdt. Weighs 2 oz.

Alloy Bellows, Inc.
Cleveland, Ohio

Circle **304** on Time-Saver Card

For more NEW PRODUCT reviews turn to page 156



New Wiper-Scraper Seal for Cylinders

Scrapes off ice, mud, tar – wipes off water, dust, other contaminants

Now, you can effectively exclude dirt and other contaminants from hydraulic cylinders under the most severe field conditions. One compact unit, the C/R SC Wiper-Scraper Seal does the job. Formerly, a separate rod scraper had to be installed in front of the ordinary wiper seal. The special machining necessary, plus the scraper ring, and retaining ring made this an expensive installation.

Chicago Rawhide's SC Wiper-Scraper Seal combines a spring brass scraper and synthetic rubber wiping member in one steel shell. The I.D. of the scraper is slightly under shaft size to provide a snug fit that will remove tar or frozen mud, but it has sufficient play within the shell to tolerate any off-center conditions of the rod such as caused by bearing "bore-slop." The cost is much lower than any other combination of scraper and wiper. "Design-in" cost is low, assembly simple. Most important is the performance contribution to the cylinder. The additional value of longer packing life and increased operating dependability with the SC Wiper-Scraper Seal will far outweigh the nominal cost.

For complete information, specifications and standard sizes, write for your copy of C/R's new Bulletin SC-100

CHICAGO RAWHIDE MANUFACTURING COMPANY

OIL SEAL DIVISION: 1203 ELSTON AVENUE • CHICAGO 22, ILLINOIS
Offices in 55 principal cities. See your telephone book.
In Canada: Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario
Export Sales: Geon International Corp., Great Neck, New York
C/R Products: C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts
Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears.

C/R

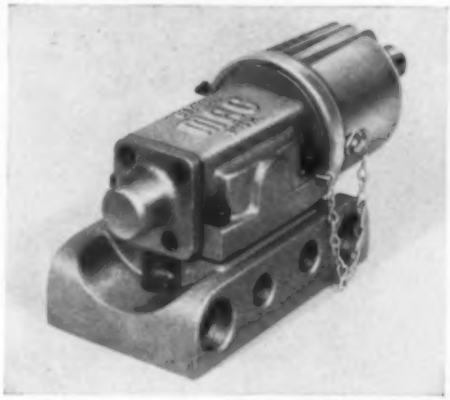
Circle **39** on Time-Saver Card

New Solenoid Air Valves Need No Accessories

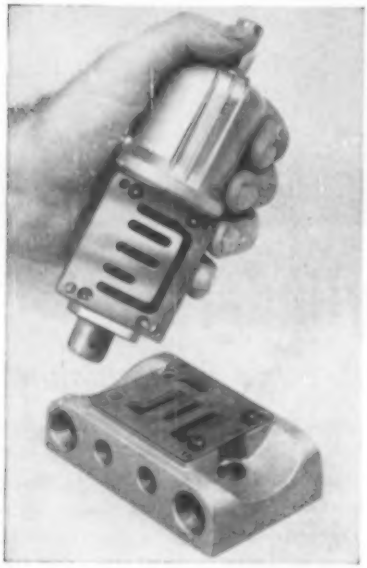
Now available for the first time are solenoid operated air valves complete with all accessories at 'bare valve' prices. Available in ¼, ⅜, and ¾ in. port sizes, they come in single- and double-solenoid types in 3-way, 4-way and 4-way 5-port models.

Features include: solenoids interchangeable on all models of a given size; pre-wired plug-in type bases, eliminating customary wiring; standardization of bodies and bases for interchangeability; unusual compactness; elimination of troublesome fasteners in solenoid assembly (which floats in rubber).

All valves are equipped with screwdriver or ball type manual solenoid operators with lock-in and lock-out feature.



Manifold type bases with common inlet exhaust, and conduit, available on ¼ in. models. For complete information, ask for MAC catalog #60.



Plug-in Connectors Now Standard on All MAC Solenoid Valves

Pre-wired bases, into which you simply plug in the valve body, are now standard on all MAC solenoid valves—both direct-solenoid and solenoid-air types. Bases are identical for single- and double-solenoid valves of a given size.

The same principle is also applied to the "add-a-unit" manifold type bases available for all MAC solenoid valves. With these, from 2 to 10 valves can be coupled with common inlet, exhaust and conduit. Individual valves can also be isolated or pressure fed in from each end.

With plug-in leads provided on all solenoids, wiring of valves has been reduced to the utmost in simplicity.

NEW!

Write today for this free air-valve manual and catalog.

You'll be surprised at how much time it will save you in picking just the right valve for your application. Ask for Catalog #60.

advances in
PNEUMATICS

MAC

evolution of valve seals...

While metal-to-metal seals work well in hydraulic valves, where inherent leakage is accepted, positive leakproof sealing is mandatory in air valves. Flexible seals are today accepted as vital and they must be so designed that sealing efficiency increases with pressure. The seal should be self-cleaning so that foreign matter won't cause leakage.

At one time O-rings were thought to be the answer. O-rings are excellent for static sealing or where travel is short. O-rings are unsatisfactory, however, when used as valve seals crossing an orifice due to the shearing action.

Developing the best design and compound for air-valve seals was a long and tedious job, since elasticity, durometer hardness, compression set, and co-efficient of friction are also important factors.

Experience to date has proven that the best valve seal is a special Buna-N base self-lubricating oil-resistant compound—bonded to the metal to keep it from distorting.

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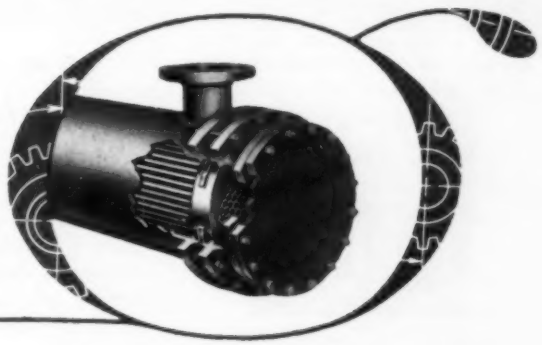
exch  anger

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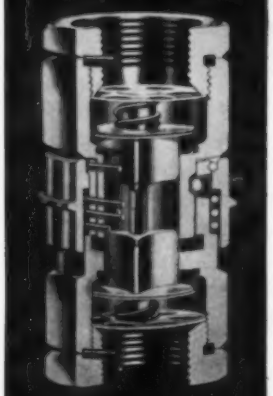

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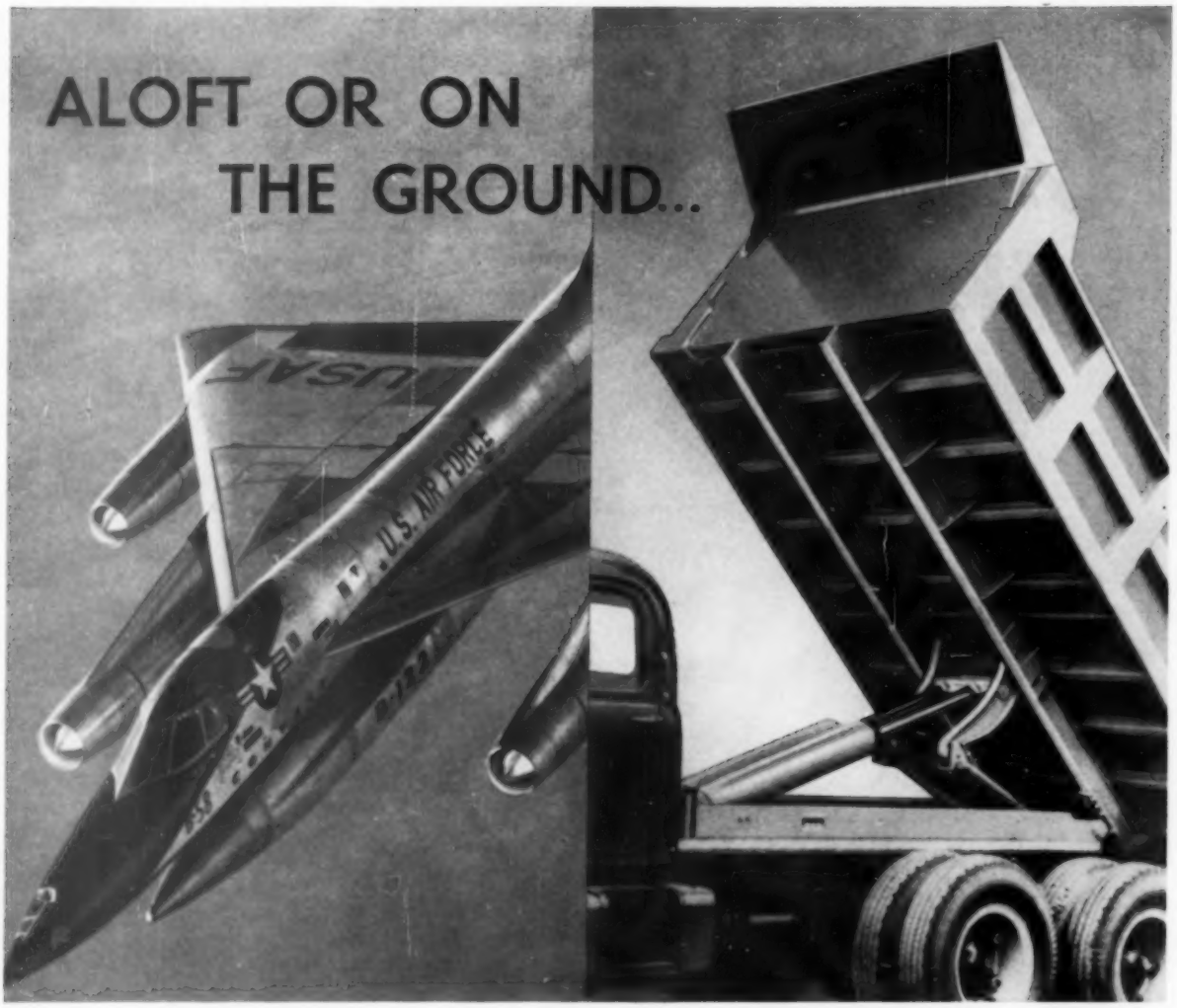

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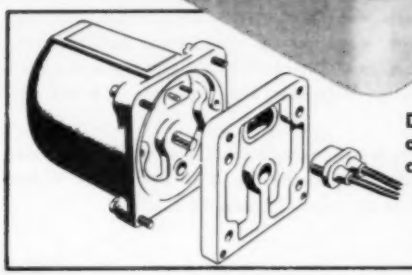

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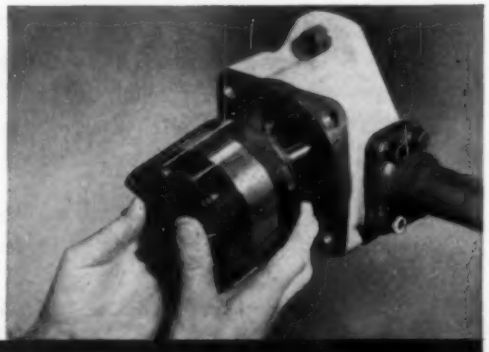

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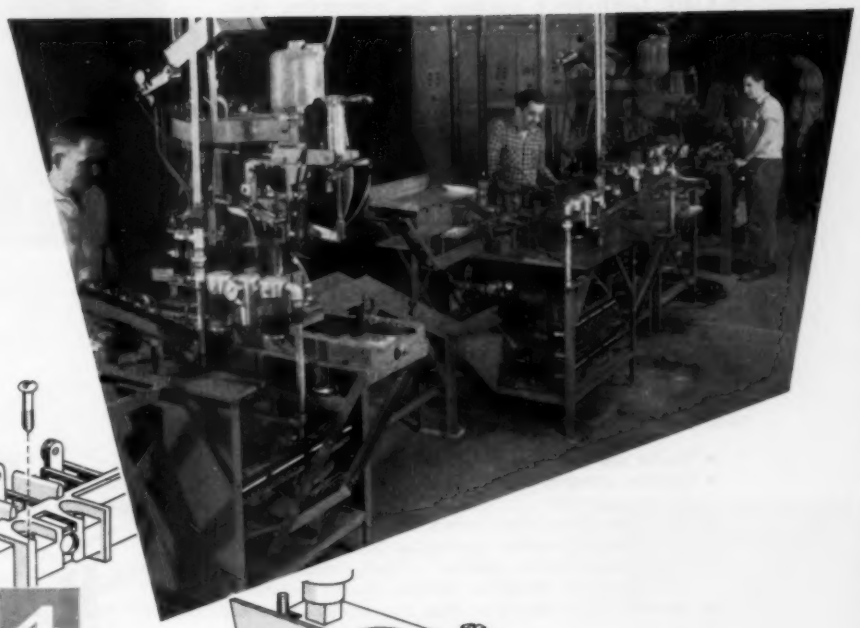
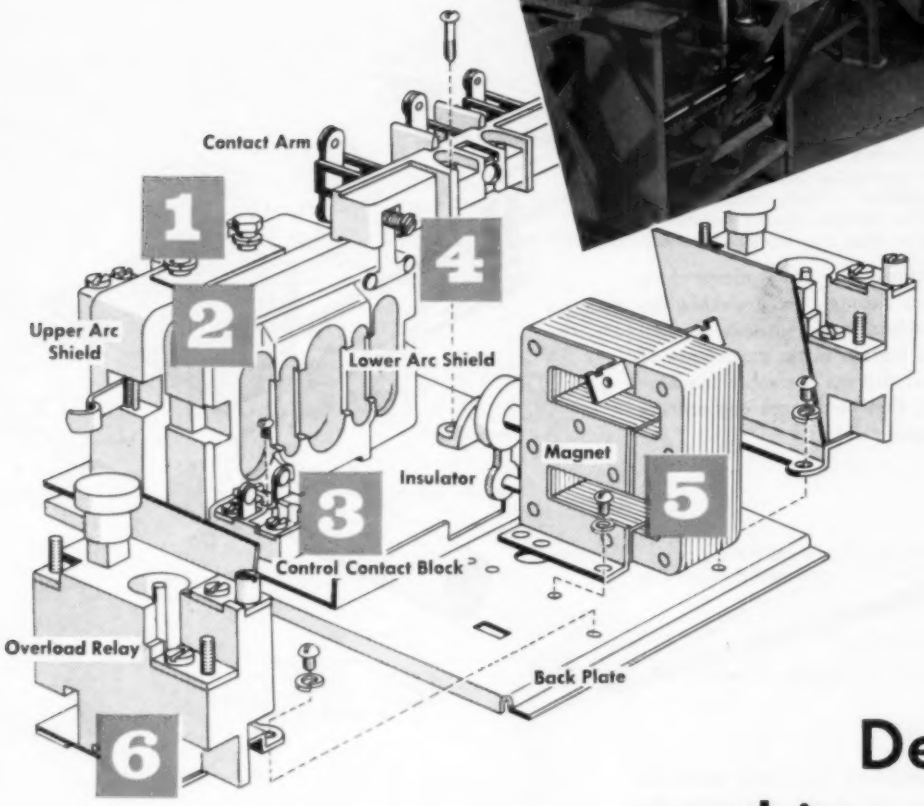




Designing machine controls for automatic assembly

With machining and fabricating production well integrated by mechanized handling between operations, management is looking to new areas for higher output. One of the most promising is *assembly*. Using transfer techniques similar to those now common in the automotive industry, welding machines, riveting machines, and assembly machines are combining functions that used to take a battery of separate machines, or a benchful of girls with screwdrivers.

AN OUTSTANDING example of mechanization is Clark Controller's machine for assembling their motor starters. The equipment originated as a management suggestion to investigate possibilities of mechanizing assembly. With that objective, Clark's manufacturing supervision and tool engineers selected the product most suited to mechanical assembly. The motor starter was chosen because it is a high volume product of standard design.

During a month of preliminary study, the starter was analyzed to determine what assembly operations were mechanically feasible, and basic drawings and models were prepared. Detailed equipment costs were compiled after consulting with component suppliers. Production cost savings were estimated. A report was then presented for management's decision.

With the go-ahead on the project, the designers turned to specific technical problems:

- Tracks and conveyors to transfer parts
- Cylinder actuated mechanisms to move parts into position for assembly.
- Electrical control—limit switch actuation, relaying, timing—to control machine sequencing. This is a major part of the design, but no problem to Clark engineers whose everyday job is designing electrical control systems.
- Redesign of the starter to adapt it to machine assembly.

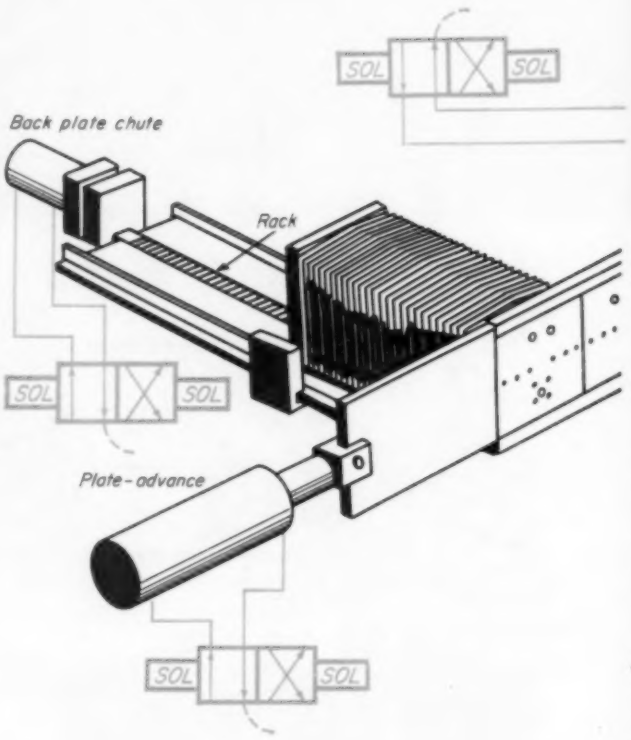
The following illustrations and descriptions show how the starter progresses through six assembly operations. Some of the problems and solutions are discussed, but many of them remain in the experience of the designers who learned that an assembly machine is a tailored-to-fit project that challenges engineering know-how and design experience.

• By **CARL W. GRABER**, *Manager of Manufacturing, Standard Products Div.*

ERWIN F. GUENNEL, *Tool Designer*

THOMAS PALMER, *Electrical Engineer*

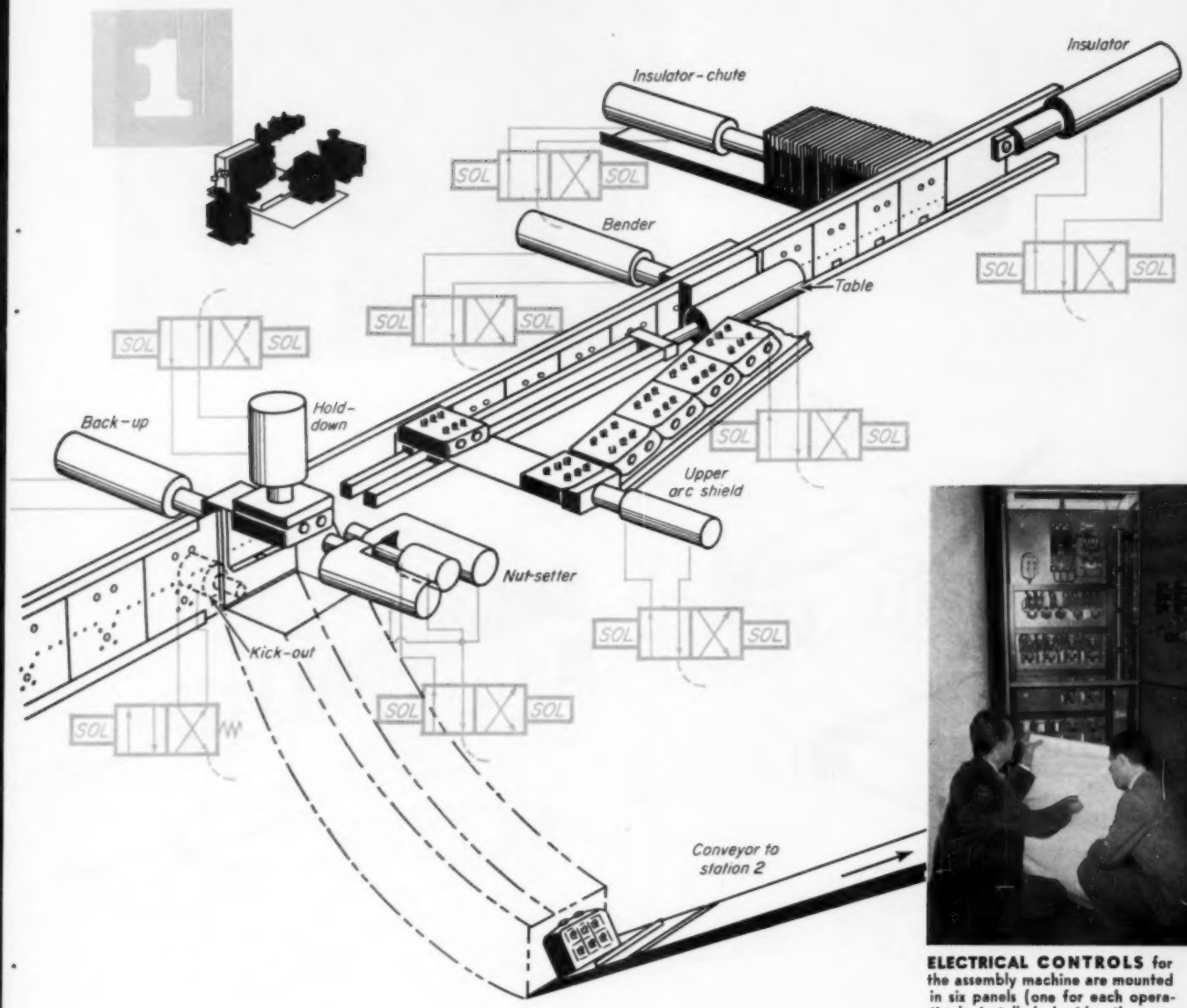
The Clark Controller Co., Cleveland, Ohio



1 First step in assembling the motor starter is to bolt the upper arc shield, containing the stationary contacts and the fish paper insulator, to the back-plate. Back plates are advanced by a cylinder-actuated mechanism which keeps the plates under spring pressure. When the plates reach a transverse track, the PLATE-ADVANCE cylinder pushes them one at a time to the assembly position under the HOLD-DOWN cylinder.

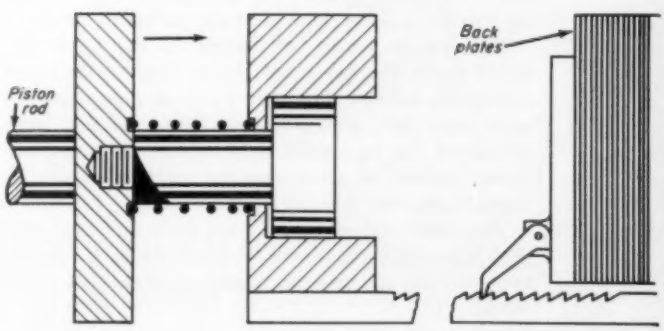
Insulators are advanced similarly by a cylinder under 15 to 20-psi air pressure. When they reach a transverse track they are advanced, one against the other, to the table position where they are picked up by bolts in the arc shields. The BENDER cylinder folds up the lower edge of each insulator as it passes. Because the insulators fit tightly against each other in the track, there was problem in sensing when they were in position for bending and assembly. Nothing projected to actuate a limit switch, One hole in the insulator now serves as a sensing position. Limit switch actuators dropping into this hole sequence the next operation.

Preassembled upper arc shields slide down a track to a position in front of the ARC-SHIELD cylinder. This cylinder then advances them onto a table and inserts two preassembled bolts through an insulator which is waiting in a track in back of the table. The TABLE cylinder advances the arc shield and insulator to the assembly position where the HOLD-DOWN cylinder clamps the arc shield while the NUT-SETTER cylinder advances, bolting the arc shield and insulator to the

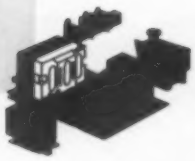


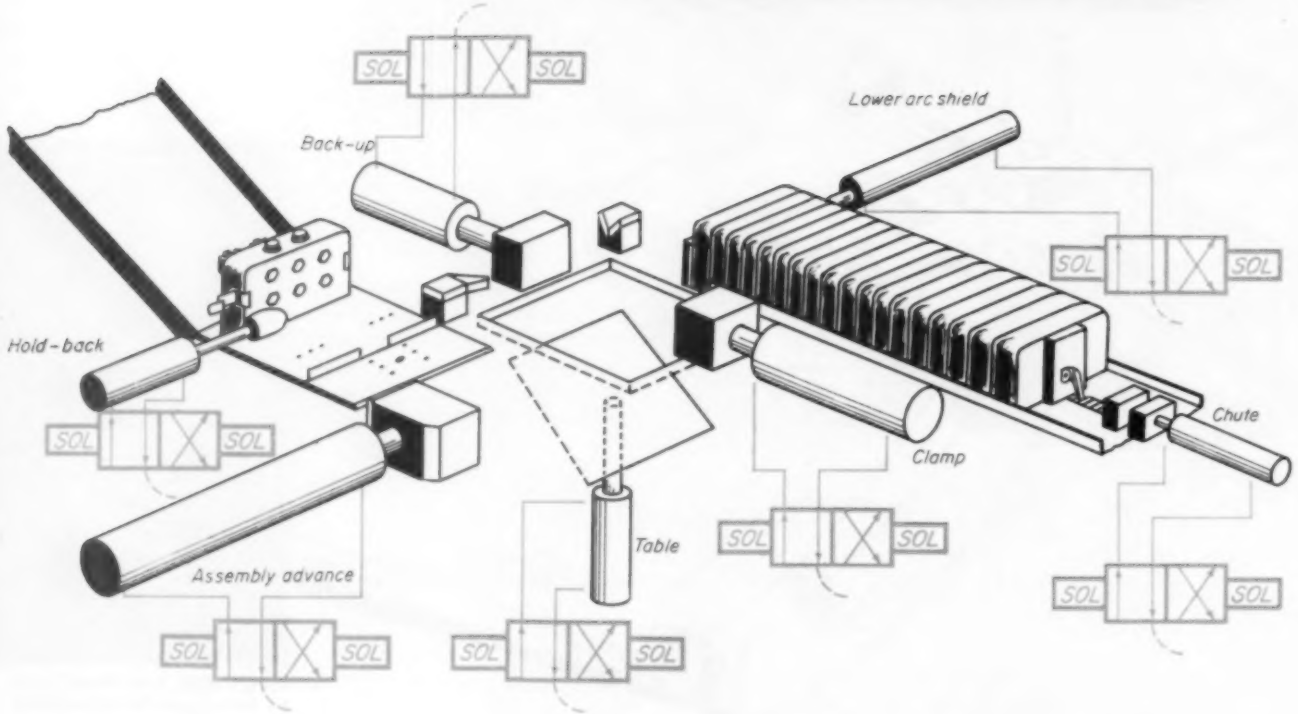
ELECTRICAL CONTROLS for the assembly machine are mounted in six panels (one for each operation) installed beside the machine. Here Erwin Guennel explains electrical circuitry to AH&P editor Allan Morris.

back plate. The BACK-UP cylinder advances to hold the back plate during bolting. After the NUT-SETTER, BACK-UP, HOLD-DOWN, and TABLE cylinders retract, the single-acting KICK-OUT cylinder pushes the back plate out of its track, dropping the assembly through the table and onto a conveyor to the next station.



TO KEEP THE RIGHT PRESSURE on the stacked back plates the Plate-Chute cylinder spring loads the rack. The pusher which bears against the plates has a pawl which engages the rack so that it moves forward with the rack, then ratchets when the rack returns. Because the cylinder extends completely each stroke, force on the back plates depends on spring pressure rather than air pressure on the cylinder.





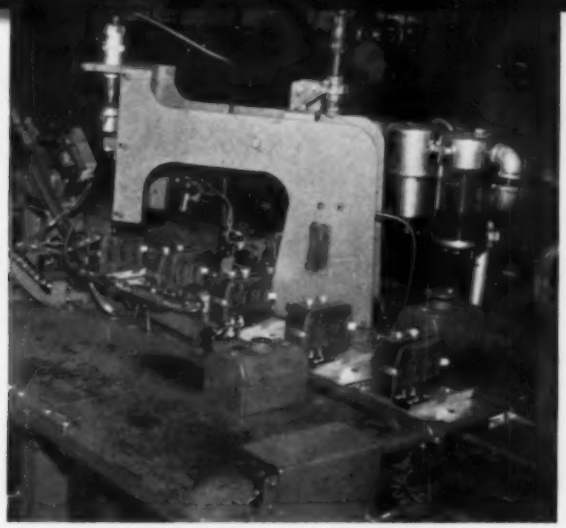
2 At station 2, the lower arc shield is clamped to the upper arc shield. The HOLD-BACK cylinder allows each partially assembled starter to slide in front of the ASSEMBLY-ADVANCE cylinder which then pushes them to the assembly position on the table. The LOWER ARC SHIELD cylinder then pushes a lower arc shield from the chute onto the partial assembly.

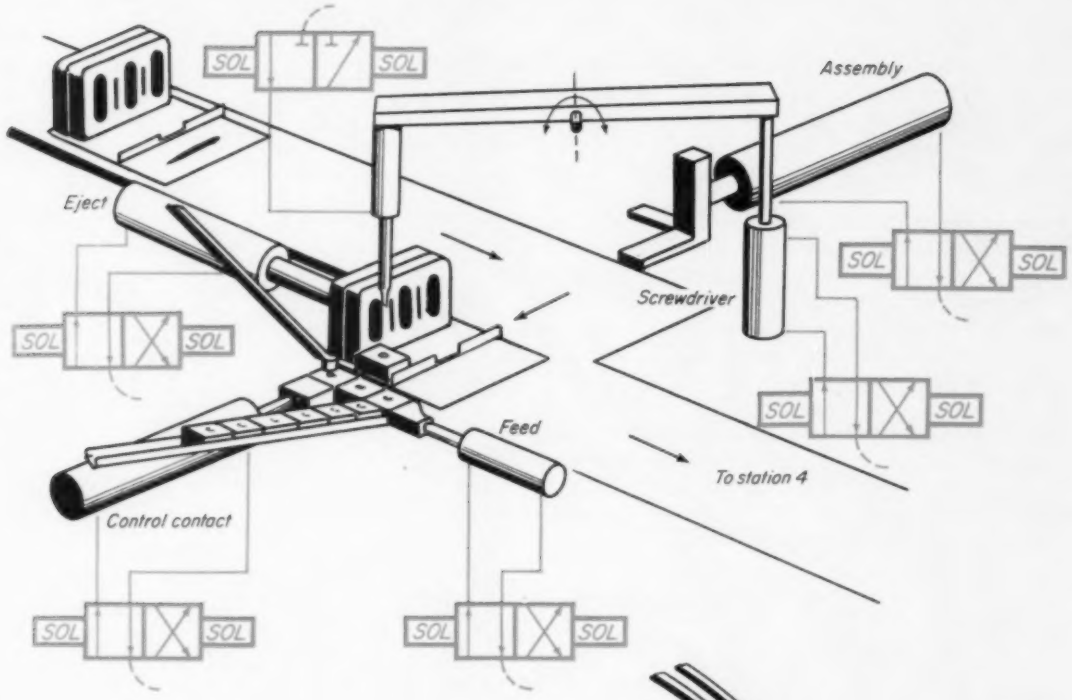
Two clamps which are hinged to the upper arc shield fasten the lower arc shield. Because these are not spring loaded, they may be in any position. To make sure they are open (as shown) so the lower arc shield can be pushed tight against the upper arc shield, a blast of air is directed at them as the ASSEMBLY-ADVANCE cylinder moves forward.

The CLAMP cylinder pushes the lower and upper arc shields together and moves the assembly back through two tabs which close the clamps over the lower arc shield.

Although the BACK-UP cylinder and CLAMP cylinder are both the same size, pressure on the BACK-UP is regulated to a lower value by a self-relieving, pressure reducing valve. The difference in the two pressures allows the CLAMP cylinder to push the assembly back against the BACK-UP cylinder. Because the regulator is self-relieving and bleeds off some air during this operation, it prevents pressure from rising above regulated value.

After assembly, the TABLE cylinder retracts, lowering, then tilting the table. The assembly slides off onto a conveyor to station 3. A time delay relay holds the TABLE cylinder retracted to insure that the assembly has time to slide off. A limit switch could not be used to sense this because its fast action would return the table before the assembly was completely off.

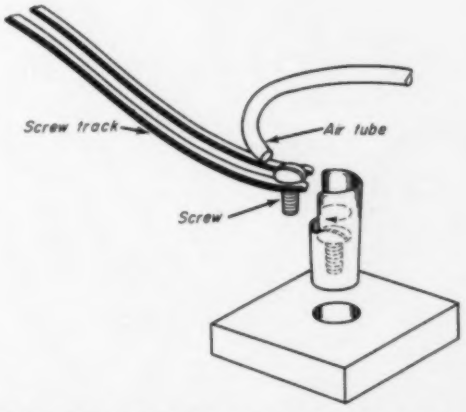




3 A control contact block is screwed onto the back plate at station 3. Partially assembled starters feed one at a time in front of the ASSEMBLY cylinder which pushes them into assembly position under the screwdriver. Control contact blocks feed down a chute and are pushed in front of the CONTROL CONTACT cylinder by the FEED cylinder.

Screws are released by a solenoid and slide down a chute into the control contact block which is then transferred onto the waiting assembly.

The SCREWDRIVER cylinder extends and lowers the screwdriver through a pivoted arm. After the control contact block is fastened, the EJECT cylinder pushes the assembly onto a conveyor to station 4.



GETTING SCREWS TO DROP into the control contact block without cocking was a problem. It was solved by directing an air stream at the screw as it comes off the track. This spins it as it drops into its hole and keeps it in the right position for driving.

Analyzing Investment For An Assembly Machine

• By **HARRY HIBLER**, *Manufacturing Engineering, Designers for Industry, Cleveland, Ohio*

MECHANIZING AN ASSEMBLY OPERATION often requires a major capital expenditure. Management must ask and answer the question, "Is it worth it?"

To find out, they must apply yardsticks to measure the investment. These simplify the problem by assumptions and projections for year-by-year estimates. The following factors must be considered:

• **Equipment Life**—Performance of new equipment must not be compared to present equipment for the same future period. The real question is whether to replace present equipment now or later.

• **Performance and Maintenance**—Today's special machines decline more rapidly in operating advantages because of new equipment which is continually being introduced. Maintenance cost for mechanized equipment will be higher, but with competent design, it will not cut too deeply into economic advantages.

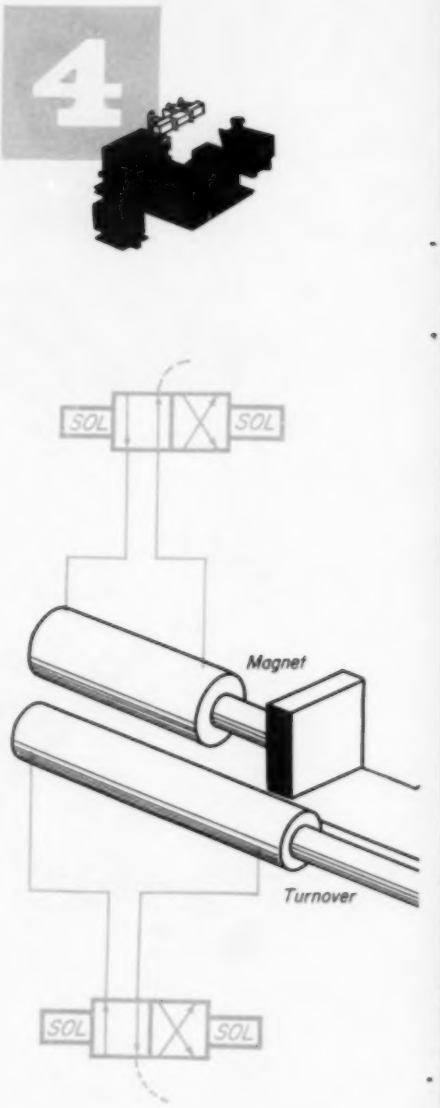
• **Income Tax**—After-tax results are what really count in working out return on investment. Since interest payments on loans are deductible while equity earnings are not, taxes vary with the "mix" of capital between debt and equity.

• **Salvage Value**—Present equipment to be retired may be easily evaluated, but future salvage value of a proposed installation may also represent an important part of the investment.

• **Future Capital Addition**—Rebuilds, overhauls, or heavy renewals must be projected both for the old equipment and for the proposed equipment.

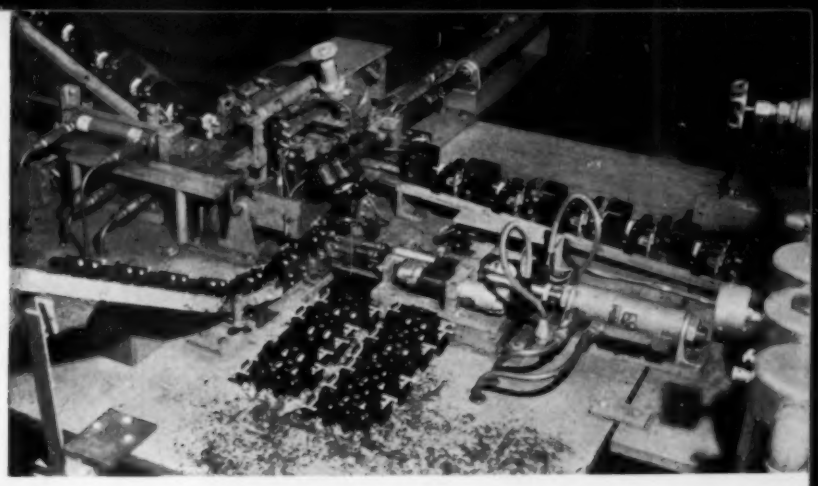
Here's how one company analyzed advantages they could gain from a proposed assembly machine:

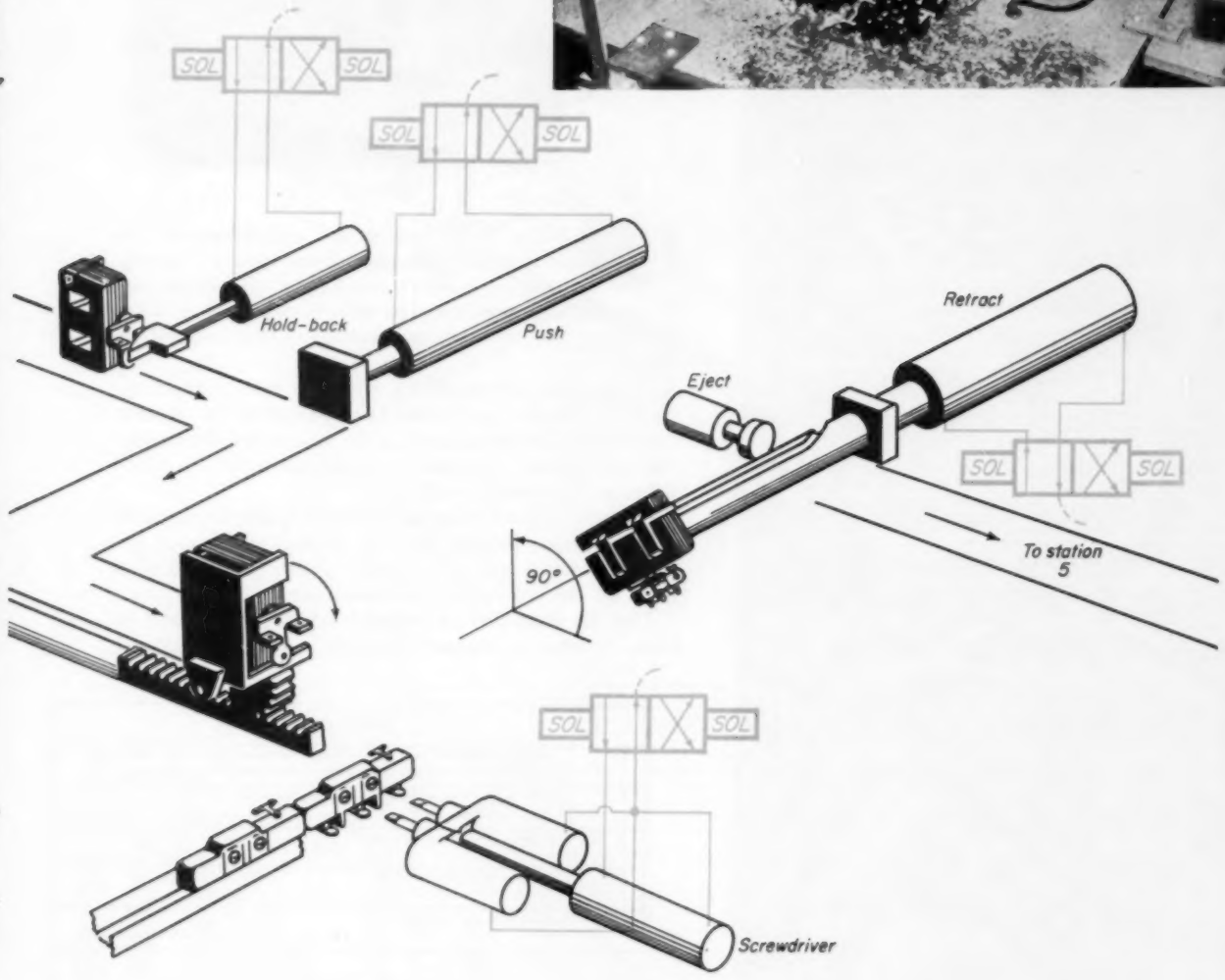
I.	Required Investment		
	Installed cost of new equipment	$76,545	
	Disposal value of present equipment	$200	
	Net required investment		$76,345
II.	Next Year Operating Advantage		
	Operating time—hours/year	2000	
	Number of operators required with assembly machine (10,000 units/day)	3	
	Number of operators required without assembly machine (10,000 units/day)	25	
	Manhours saved per year	44,000	
	Labor savings per year at $1.80/hr.	$79,200	
	Maintenance cost	$ 1,000	
	Estimated power cost	$700	
	Property taxes and insurance	$ 1,909	
	Net decrease in operating costs		$75,591
III.	Return on Investment		
	Next year advantage after income tax (Tax rate of 52%, estimated service life of 5 years based on design of assembled unit)	$36,284	
	Total depreciation allowance (allowing $2000 terminal salvage of assembly machine at end of 5 years)	$ 9,568	
	Amount available for return on investment		$26,716
	After tax rate of return on investment ($26,716 ÷ $76,345)	35%	



4 Two rotary motions combine with linear movements at station 4, where contact arms are screwed onto magnet push rods before mounting these subassemblies on the starter back plates at station 5.

As a magnet is released in front of the PUSH cylinder by the HOLD-BACK cylinder, it is advanced to the MAGNET cylinder.



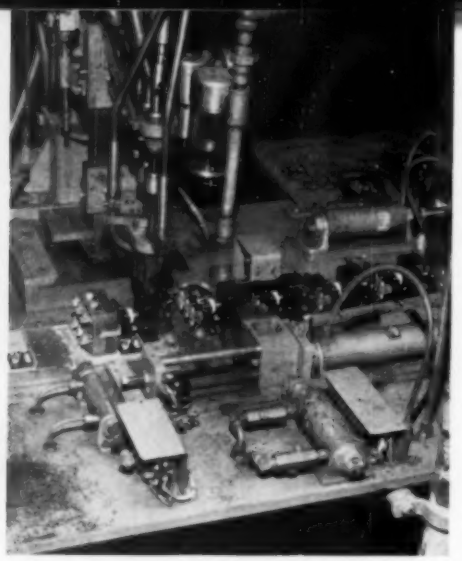


This pushes it onto a cradle which is hinged at the bottom and attached to a pinion gear.

This gear meshes with a rack cut on the TURNOVER cylinder's rod, so that when the cylinder retracts, it rotates the cradle and magnet 90 degrees to a position for screwing on the contact arm.

Contact arms, with preassembled screws, slide down a chute in front of the screwdrivers. The pneumatic screwdrivers start rotating as they are advanced by the SCREWDRIVER cylinder. After the screwdrivers have torque stalled, to insure proper tightness, the cylinder retracts them and they stop.

The magnet subassembly must be rotated 90 degrees again so it is in position for installing on the back plate. This is done by the RETRACT cylinder which has a spiral groove cut in its pilot rod. As the pilot rod slides through a block, a pin in the block engages the groove and forces the rod to rotate. When the magnet subassembly reaches the discharge chute, further retraction of the RETRACT cylinder withdraws its fingers from the magnet. The EJECT cylinder then advances to station 5.



5 At station 5, the magnet and arm subassembly is mounted on the back plate. This requires a rectangular motion in which two fingers advance through the magnet and move the assembly to mounting position. The fingers then retract in two motions to their original position.

The magnet subassembly is advanced to a position opposite the fingers by a cylinder at station 4. The MAGNET cylinder then advances, inserting the fingers into the magnet. The FEED cylinder then moves the magnet under the screwdriver at the assembly position.

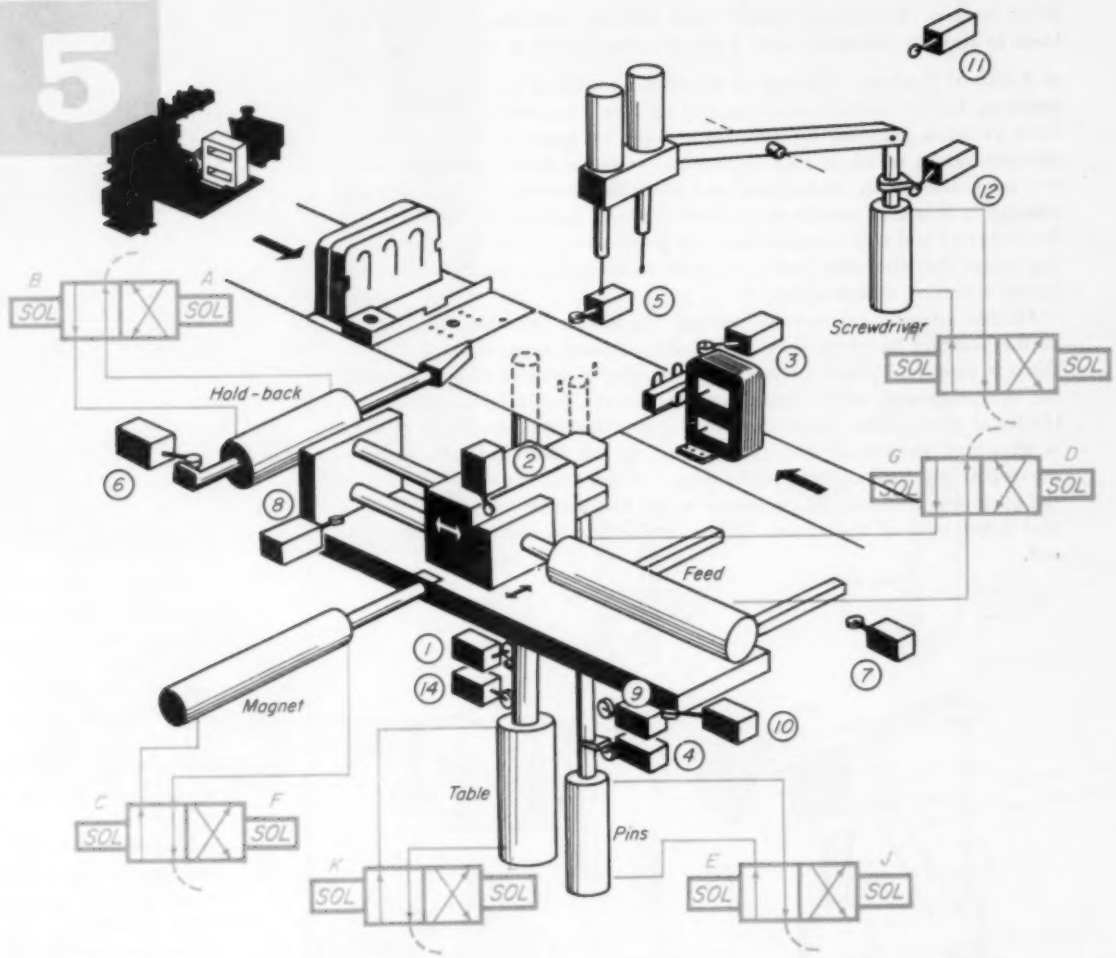
The PINS cylinder mounted vertically under the assembly position pushes locating pins up through the magnet feet and the MAGNET and FEED cylinder retract in turn to allow room for the screwdriver to come down.

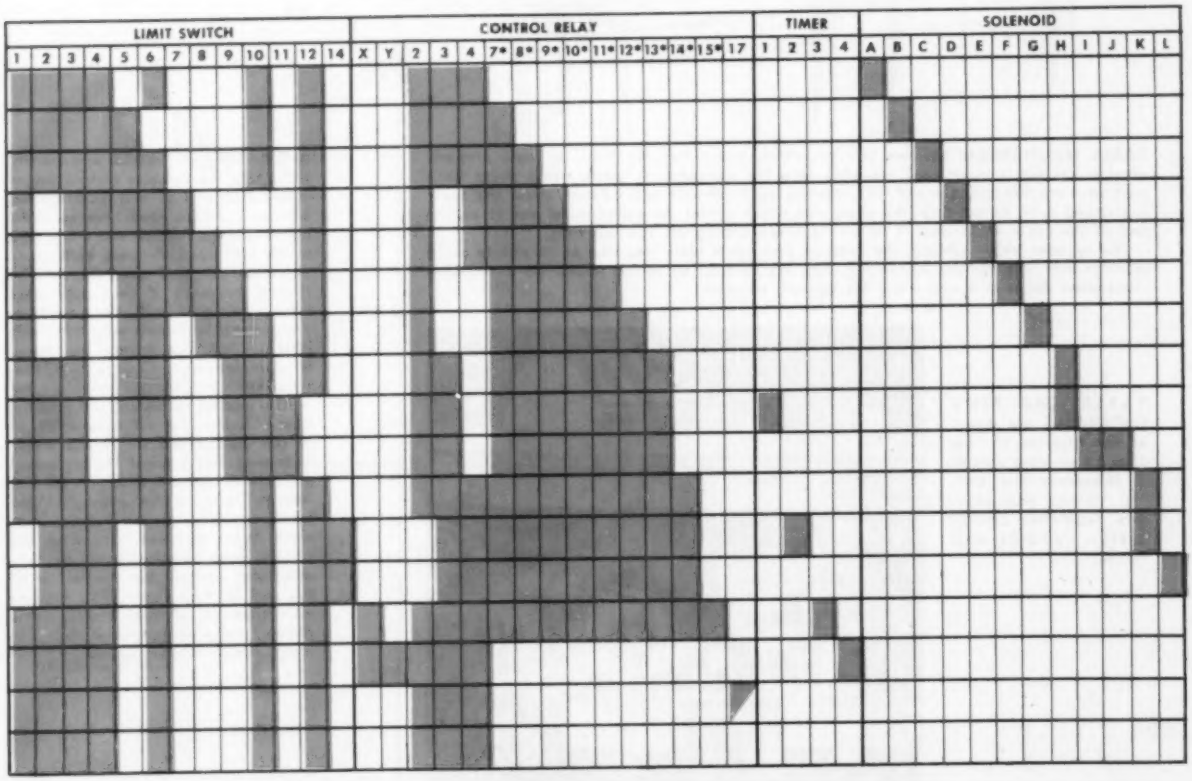
After the SCREWDRIVER cylinder extends, dwells, and retracts to drive the magnet's fastening screws, the PINS cyl-

	OPERATION
1.	Table up. *Magnet* and *Feed* cylinders retracted. *Hold-Back* cylinder advanced. Screwdriver up. Magnet in position. Pins down.
2.	*Hold-Back* cylinder retracts admitting assembly to work position.
3.	*Hold-Back* cylinder advances.
4.	*Magnet* cylinder forward.
5.	*Feed* cylinder forward.
6.	*Pins* cylinder up.
7.	*Magnet* cylinder back.
8.	*Feed* cylinder retracted.
9.	Screwdriver down and dwell.
10.	Screwdriver timed out.
11.	Screwdriver up. Pins retracted.
12.	Table down and dwell.
13.	Timer 2T timed out.
14.	Table up.
15.	Timer 3T timed out. Actuate all relay trip coils. Start timer 4T.
16.	Timer 4T timed out.
17.	As each trip coil is actuated, contacts of its relay deactuate it.

*Latching relay

5


Screwdriver
Hold - back
Feed
Magnet
Table
Pins
SOL


LIMIT SWITCH
1 2 3 4 5 6 7 8 9 10 11 12 14
CONTROL RELAY
X Y 2 3 4 7* 8* 9* 10* 11* 12* 13* 14* 15* 17
TIMER
1 2 3 4
SOLENOID
A B C D E F G H I J K L

inder retracts. The TABLE cylinder then retracts, lowering and tilting the table to slide the assembly onto a conveyor to station 6.

• **Control System**—Typical of all cylinder actions in the machine, 2-position, double solenoid valves control air flow. Sequencing is initiated by limit switches actuated by cylinder motion or position. These switches energize relays which in turn actuate the valve solenoids. Latching relays are used extensively throughout the electrical circuits. Their chief advantage is that they remain in position if power fails, so the machine can be re-started and will continue from the point where it was stopped. Latching relays also eliminate lock-in contacts to keep them energized after the initial actuating switch opens.

Double solenoid valves were selected for similar reasons. They remain in the position to which they have been actuated, regardless of whether there is electrical power or not. They require a *positive* electrical signal for operation and, unlike spring-actuated valves, avoid false operation if electrical power fails. Sequencing of the electrical and pneumatic systems is shown in the circuit and chart. Color in the chart indicates that the corresponding limit switch, relay, timer, or solenoid shown at the top of the column is actuated. The sequence at left in the table tells when the control is actuated or deactuated. Timers are shown in color until they time out.

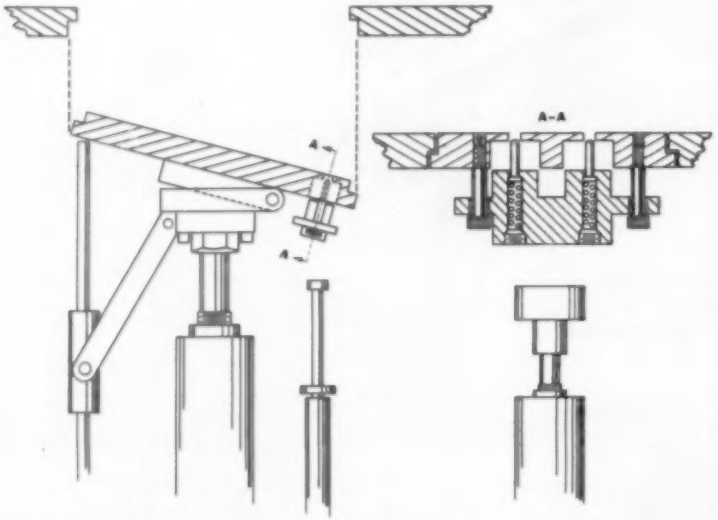


TABLE MECHANISM has two features which insure that the table re-seats properly after it has slid a completed assembly onto the conveyor. A guide which slides on a post prevents the cylinder rod from turning as it retracts and extends. Also, the table is stepped to fit its opening. The same post which guides the cylinder rod also stops one end of the table and makes it tilt on its hinge, sliding off the assembly.

The cylinder which actuates the locating pins has a plate mounted on its rod to avoid misalignment with the pin mechanism. Pins are held up by spring force. The pin-holding mechanism drops as a unit when the cylinder retracts.

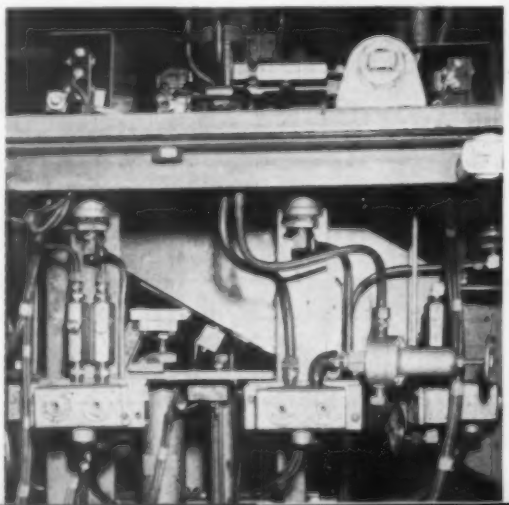
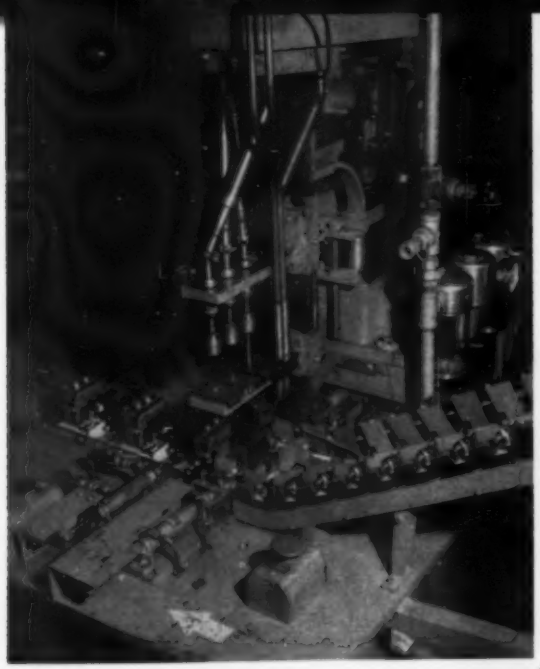


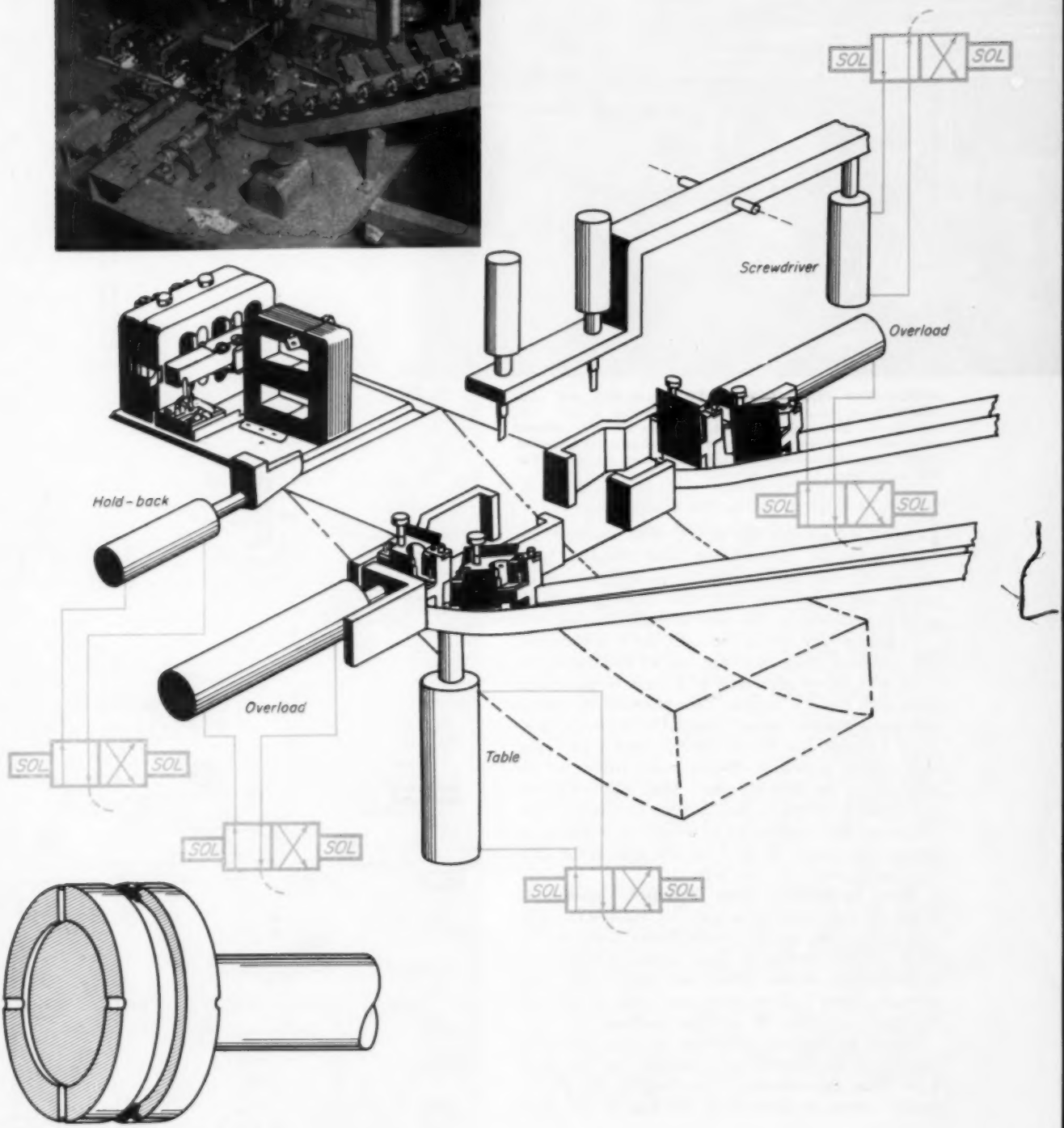
TABLE AND PINS CYLINDERS are shown at the bottom of this view below work station 5. Numerous flow control valves and pressure regulators control piston speeds and forces.

6 Final operation is mounting the two overload relays at station 6. As the partially assembled starter is conveyed into work position, the OVERLOAD cylinders push two overload relays from their feed chutes against stops over the starter back plate. The OVERLOAD cylinders hold the relays in place as the SCREWDRIVER cylinder advances, lowering the screwdriver through a pivoted arm, then retracts after dwell to insure correct torque. The TABLE cylinder retracts, lowering and tilting the table, so the finished starter slides off.

A CHANGE IN SEALS and modifications to the cylinder pistons solved initial problems of fast acceleration. Because cylinder loads are so light, cylinder static friction was a big part of the total load. Pressure built up to overcome this, and when the cylinder started to move it shot out, often tossing a part off the machine. Various seal lubricants were tried with little success. The answer was found in changing from O-rings to Quad-rings which require less squeeze.

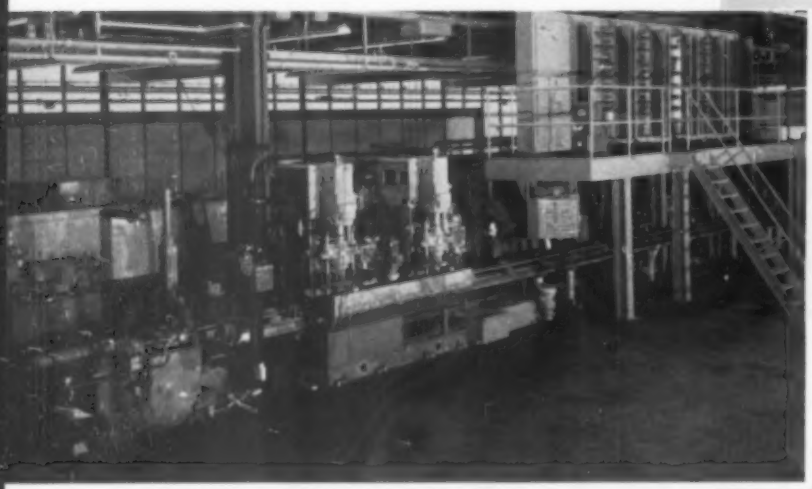
Also adding to the original problem was a Jo-Block effect caused by oil in the compressed air as the piston bottomed flat against the cylinder's end blocks. Adhesion of this oil was enough to hold the piston to the block, requiring pressure to separate them. When this was discovered, the pistons were counterbored, so they could not squeeze out all the air at the end of their stroke. Two grooves were then cut at right angles in the piston's remaining annular face, to make acceleration smoother.




SOL
SOL
Screwdriver
Overload
Hold - back
SOL
SOL
Overload
Table
SOL
SOL
SOL
SOL

Differential circuitry

• By **WARD F. DIEHL,** *Senior Hydraulics Engineer, Process Development Section, General Motors Corp., Warren, Michigan*



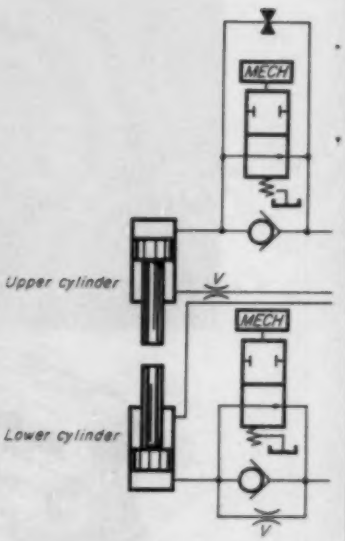
AUTOMATIC TRANSMISSION TORUS PARTS ARE ASSEMBLED on this machine which puts together a shell, hub, vane carrier, spacer, and 36 vanes. The shells with preassembled vanes are transferred on pallets in a rectangular path by two transfer bars and turn-arounds. Shot pins locate the work within .002-in. accuracy at each station.

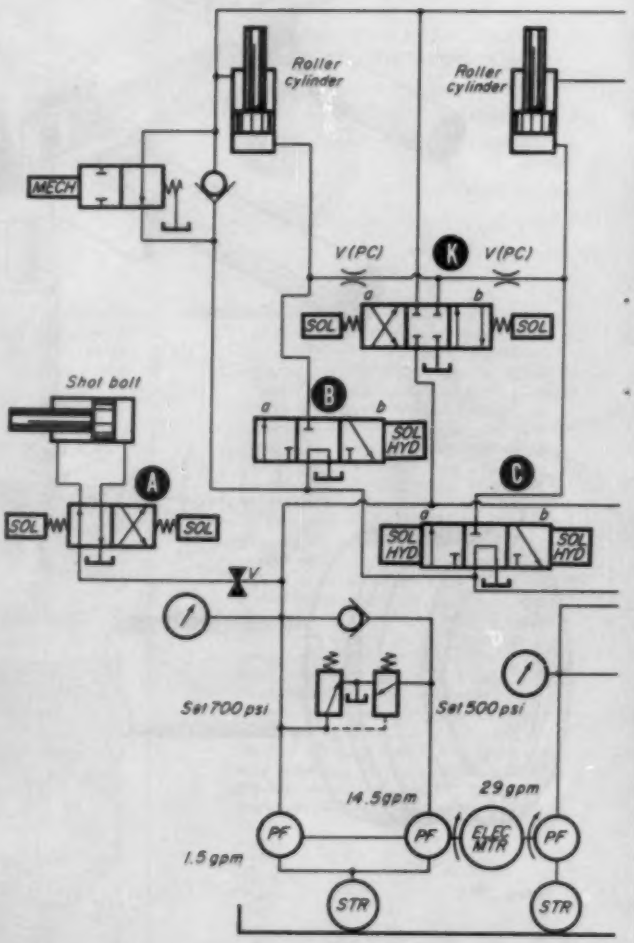
IN JUST 5.5 seconds this section of an assembly line for automatic transmission fluid coupling parts clamps 36 vanes into a torus-shaped shell, rotates the hub to fasten the vane tabs, then replaces it on its pallet for transfer to the next assembly station.

To get the high speeds necessary for this fast cycle, GM engineers made extensive use of differential circuits, with valves sequenced to form a simple circuit when high force is needed. They powered the system with a combination pump (integral hi-lo circuit) having a 1.5-gpm, low volume section, and a 14.5-gpm, high volume section. A 29-gpm pump driven off the other end of the electric motor's shaft supplies a fluid motor which rotates the hub. During part of the cycle, this pump also supplies oil to extend the roller cylinders at high speed. These force dies against the spinning hub to bend the vane tabs.

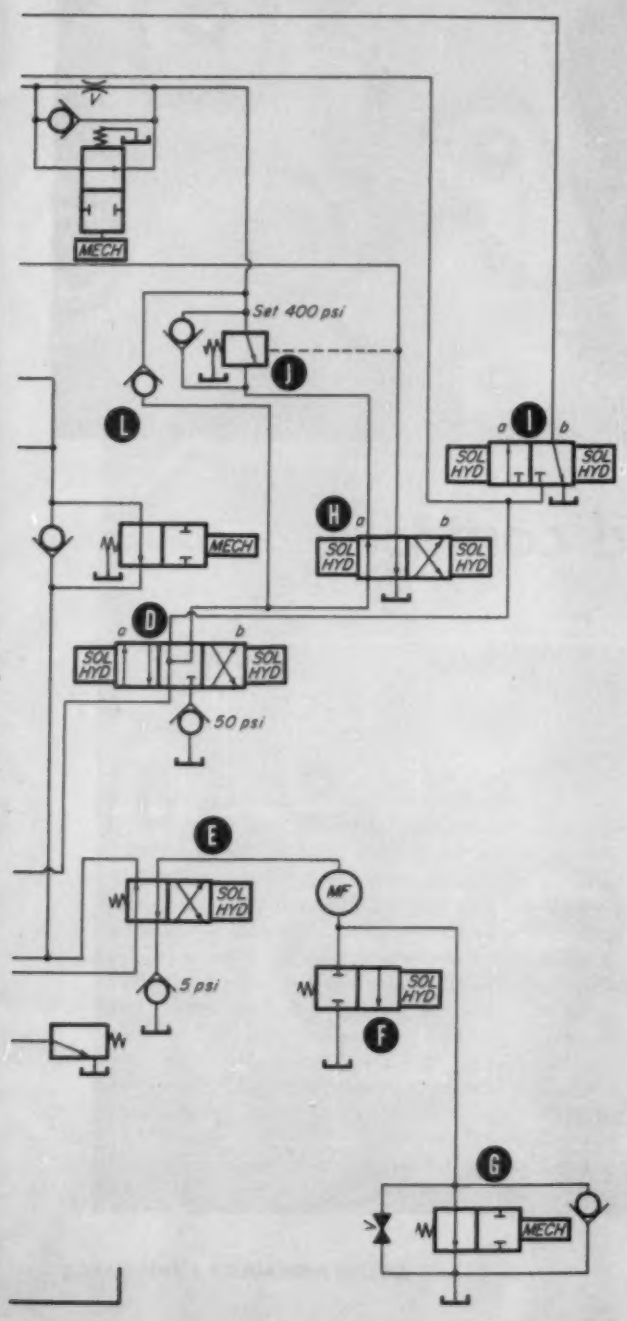
• **How hydraulics does assembly motions**—When the hub, with vanes installed, reaches the spinning station, the upper cylinder moves down and the lower cylinder moves up. Both extend at high speed in differential circuits. When they meet at the workpiece, the lower cylinder continues to lift the part and the upper cylinder to the spinning position.

During the upward movement, the roller cylinders, supplied by the 29-gpm pump, extend roller dies about 6 in. When the workpiece is in position, the 29-gpm pump's output is directed to the fluid motor which





speeds transmission assembly



spins the hub. The roller cylinders are then extended by flow from the combination pump.

When spinning is completed, a shot pin extends to locate the workpiece which is then lowered and replaced on its pallet in the same rotating angular position it was in before being lifted.

• **Valves set up differential circuits**—To extend the upper and lower cylinders to the workpiece quickly, valve *D* is left in neutral, so that the combination pump supplies both cylinders in parallel through valves *H* and *I*. Valve *H* is actuated to position *b*, setting up a differential circuit for the lower cylinder with return flow from its rod end through check valve *L*. Sequence valve *J* remains closed until the lower cylinder contacts the workpiece and builds up pressure. A differential circuit for the upper cylinder is formed by actuating valve *I* to its *a* position.

When the cylinders meet at the work, limit switches actuate valve *D* to position *b* connecting both lines of the upper cylinder to tank through a 50-psi check valve. Pump flow is directed to the head end of the lower cylinder which is now connected in a simple circuit (sequence valve *J* open) lifting the work and the upper cylinder. The work is clamped between the two cylinders.

During this upward movement of the work, valves *B* and *C* shift to their *a* positions and the roller cylinders advance in a differential circuit. Exhaust flow from the cylinders is through their corresponding deceleration valves back to the 29-gpm pump supply line.

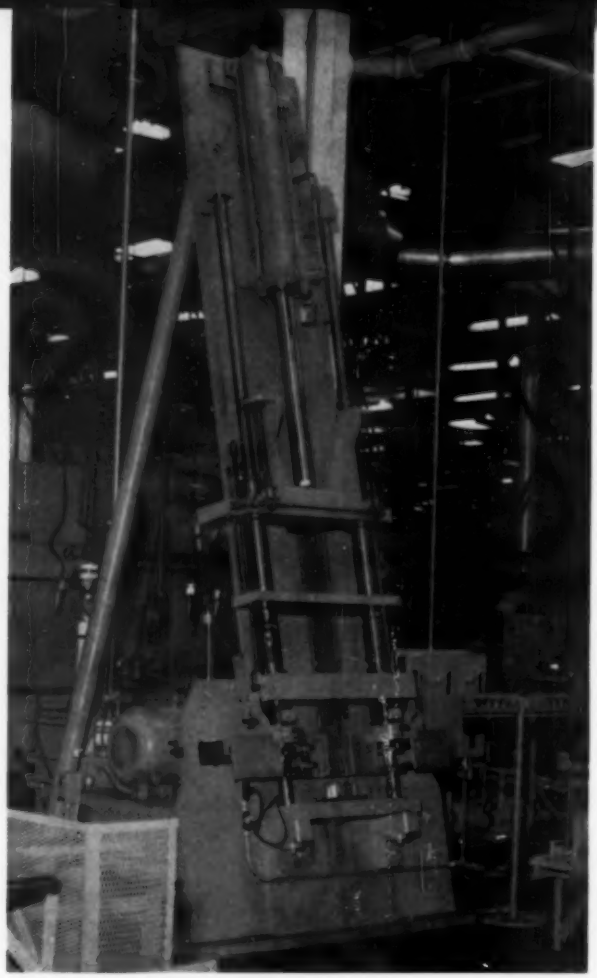
Just before the roller dies contact the work, valves *B* and *C* shift to neutral, and valve *K* shifts to its *a* position. This connects the roller cylinders in a simple circuit supplied by the combination pump which slowly feeds the rollers into the vane tabs. Meanwhile, valve *E* shifts to its *b* position connecting 29-gpm to the fluid motor for spinning. Valve *F* is momentarily energized to get deceleration valve *G* off its cam.

The motor turns through 5 revolutions at 200 rpm, then a cam on its reduction gearing actuates its deceleration valve and trips a limit switch. The switch energizes valve *A* to extend the shot bolt. Valve *K* is de-energized and solenoids *b* on valves *B* & *C* are energized, returning the roller cylinders.

The part must now be placed back on the pallet in the same position it had before. This is done by actuating valve *D* to its *a* position. This feeds oil differentially to the upper cylinder. The lower cylinder is forced downward discharging oil differentially over the 50-psi check valve, thus clamping the work during lowering.

When the part is back on the pallet, valve *H* is de-energized. Valve *I* is energized to *b* position and *H* to *a* position retracting both upper and lower cylinders to starting position. Valves *B* & *C* are de-energized, unloading the 29-gpm pump. ▼▼▼

Cylinder speed can be decreased and accurately controlled for any part of its stroke with a cam-operated deceleration valve having a restrictor valve bypass. Varying cam length and position offers flexibility.



Deceleration valve gives fine feed control

• By **E. E. ELDRIDGE,** *Vice President, Burr Oak Tool & Gauge Co., Sturgis, Mich.*

CONDENSER and evaporator tubes are expanded to fasten fins, staked into their end plates, and sized to length on this machine.

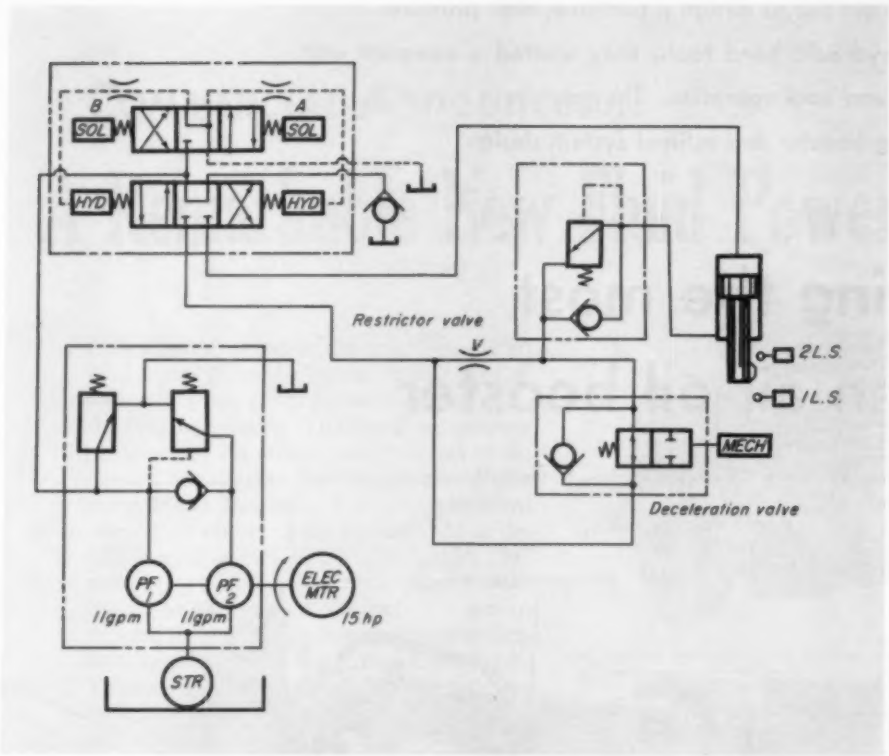
The tube coil reaches the machine loosely assembled and consists of tubes, fins, and end plates. A hydraulic cylinder expands all tubes simultaneously by forcing rods through them.

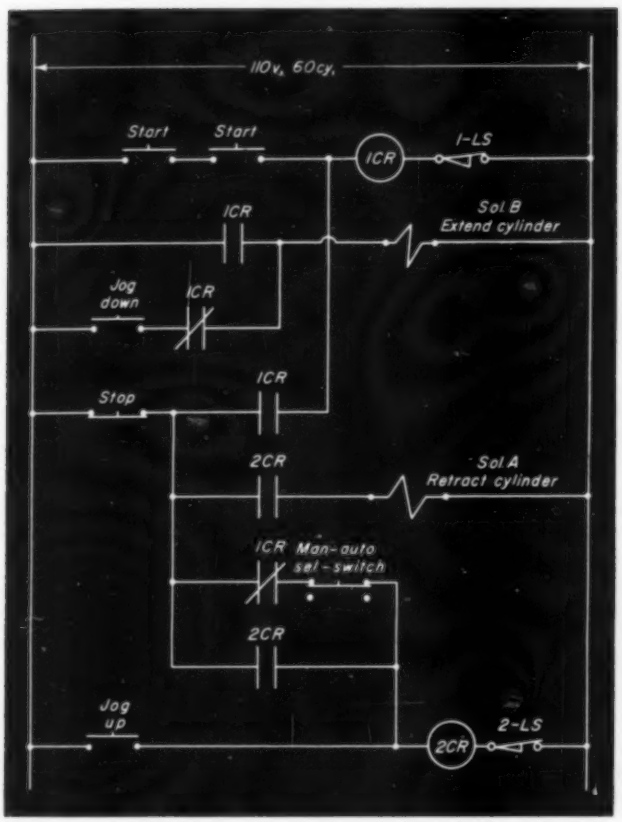
Near the end of the machine's downstroke, it stakes bottom end plates in place. It also sizes the overall length of the coil by forcing the top plate to its correct position.

• **Operation**—Pressing two pushbuttons starts the machine. The cylinder extends and retracts automatically. Its stroke is set by two limit switches. The cylinder extends at full speed until the expanding rods reach the tubes. At this point a cam actuates a deceleration valve which slows ram speed during expansion. A restrictor valve bypasses the deceleration valve for speed adjustment. After expanding the tubes through the top endplate, the cam rides off the deceleration valve and the cylinder returns to full speed.

Staking the end plates and sizing requires twice as much force as coil expanding. The unloading valve is set so that flow for staking and sizing comes from one pump only. This requires only half the horsepower since both pumps have the same capacity. This operation is only a small portion of the total cycle, so overall cycle time is not increased much by slowing to half speed with one pump.

A 2:1 piston rod retracts the cylinder at twice the speed at which it extends. ▼▼▼





A 15 HP MOTOR drives the two 2000-psi pumps that power the circuit. Both pumps deliver to the circuit until working pressure exceeds setting of the unloading valve. Pump 1 continues to supply oil to the circuit while pump 2 unloads tank. Working pressure of pump 2 is limited by the setting of the integral relief valve.

A 3-position, pilot-operated, solenoid valve controls cylinder direction. Chokes in its pilot section control shifting speed and prevent shock.

A deceleration valve, actuated by a cam on the piston rod, slows cylinder speed while expanding the tubes through the top end plate. The restrictor valve adjusts expanding speed.

The counterbalance valve holds the piston when it is retracted or stopped during its stroke.

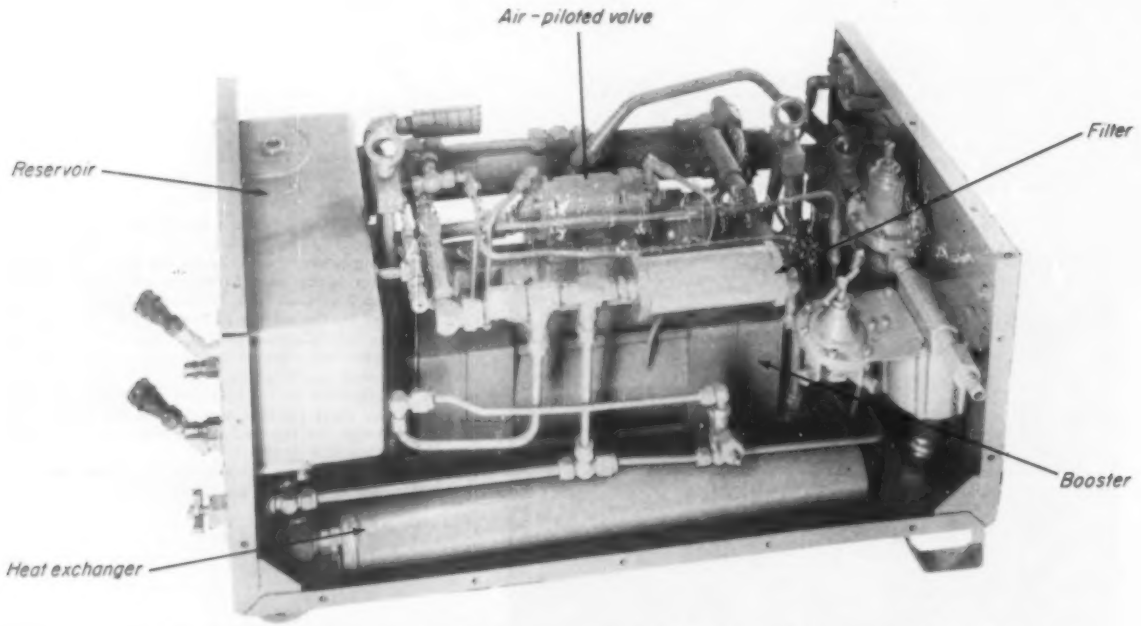
DEPRESSING THE START BUTTONS energizes relay 1-CR through normally-closed limit switch 1-LS. This actuates solenoid B to extend the cylinder. It also opens the circuit to the JOG DOWN button, and locks in relay 1-CR through the STOP button.

When the cylinder starts extending, limit switch 2-LS closes but 2-CR does not energize until the cylinder extends fully and opens 1-LS de-energizing relay 1-CR. Solenoid B is de-energized and solenoid A energized. The cylinder retracts until 2-LS opens, de-energizing 2-CR and completing the cycle.

When M. B. Sturgis set out to design a portable, high pressure power source for hydraulic hand tools, they wanted a compact unit with high capacity and cool operation. They got it with a reciprocating booster and refined system design.

Getting the most out of an air-oil booster

• By **RALPH LATHAM,** *Chief Engineer, M. B. Sturgis, Inc., St. Louis, Mo.*



PORTABLE HYDRAULIC POWER PACK for assembly operations like riveting, punching, clamping keeps power requirements low because its booster operates only when flow is required.

A MAJOR part of our development of a portable power source for bolt pullers, rivet squeezers, pull broaches and similar hydraulic hand tools was getting maximum delivery. Operating speed of the reciprocating booster depends on the difference between inlet air pressure, which is regulated, and outlet oil pressure which is set by the load. This difference determines acceleration of the booster in each direction, and consequently its reciprocating speed and delivery.

Our prototype model showed up this reasoning. Air input pressure is at the usual plant level of about 90 psi. Pressure drops across some of the components in the air system slowed down the booster and limited its output. We increased subplate passages of the 4-way air valve controlling the booster. We also went to larger tubing, and changed 90-degree elbows to 45-degree elbows. We eliminated a needle valve from the air system because we found there was a high pressure drop across it. With these changes we got a good improvement in output.

• **Eliminated cavitation**—Another problem in developing this power package was cavitation at higher booster speeds. To limit oil temperature, we had installed a heat exchanger between the reservoir and

COMMERCIAL Announces...

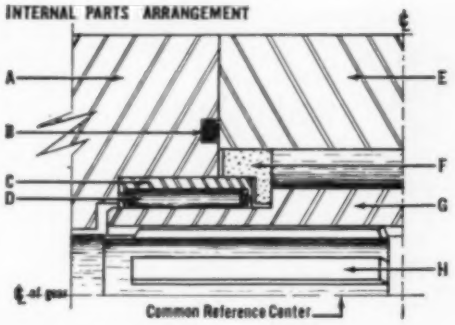
A Remarkable New Fluid Power Pump

COMMERCIAL presents the new, Series 15H fluid power pump—a logical extension of its Series 36H line which has received such outstanding acceptance. This small powerhouse possesses all the proven basic features of the larger COMMERCIAL fixed displacement gear pump but is designed for those applications where flow requirements are less. The Series 15H is made in ½", ¾", 1", 1¼", 1½", 1¾" and 2" gear widths and covers a delivery range from 3 to 15 gpm at 1200 rpm. It is recommended for continuous duty operation at pressures up to 2000 psi—at speeds up to 2400 rpm. Volumetric and mechanical efficiency rate over 90%. 15H pumps are available for flange or pad mountings of many styles and can be furnished with ports to accept tapered thread, straight thread or SAE split flange fittings.

High performance for keeps

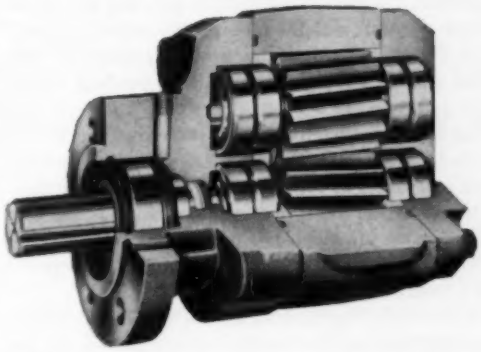
Perfect alignment is "built in" these pumps because of their unique basic construction which establishes the machining of all internal parts from one common reference, the gear center line. (See drawing.)

INTERNAL PARTS ARRANGEMENT



A-bearing carrier
B-"O" ring seal
C-bearing outer race
D-bearing roller
E-gear housing
F-floating thrust plate
G-gear
H-drive shaft spline

As shown, gear bearings also act as dowels—outmoded dowel pins are eliminated.



Matched helical gears having mirror finish ground on all surfaces contribute to high volumetric efficiency and quiet operation. Thus, complete sealing is maintained—tooth to tooth and tooth to gear housing. Ruggedness, greater load capacity and dampening of unbalanced internal loading are assured by using integral gear hubs to serve as journals for the pump's oversize gear bearings. In order to meet its own exacting standards, COMMERCIAL must, and does, produce its own gears.

A dynamic seal is maintained between gear faces and special bronze alloy gear thrust plates. The entire thrust plate "closes in" against the gear face because of pressure pocketed behind the plate, thus compensating for any wear on its gear contact surface. Because the sealing area is confined to a small portion of the contact surface, the amount of friction has no appreciable effect on pump mechanical efficiency.

Engineering experience available—personal technical service and assistance is yours for the asking. For more information write to Commercial Shearing & Stamping Company, Dept. A-19, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

booster. Expanding air, exhausting from the booster, cools oil flowing through the heat exchanger. But, we found that oil flow was not fast enough to supply the booster. We pressurized the reservoir with 15-psi air pressure, regulated from the air input to the unit. This supercharging, combined with larger check valves in the inlet lines to the booster, increased its volumetric efficiency above 85%.

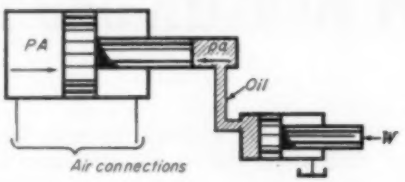
To prevent oil from flowing back into the air regulator when the unit tilts for moving, we added a check valve in the air pressure line to the reservoir. The valve has guided poppets to avoid any peening of its seat.

During field tests we found that pressure fluid could be trapped in the high pressure system with no way of venting it back to tank so that hose could be disconnected. Furthermore, the accumulator stored excess fluid under pressure. To remedy this we installed a needle valve between the pressure line and reservoir to vent pressure.

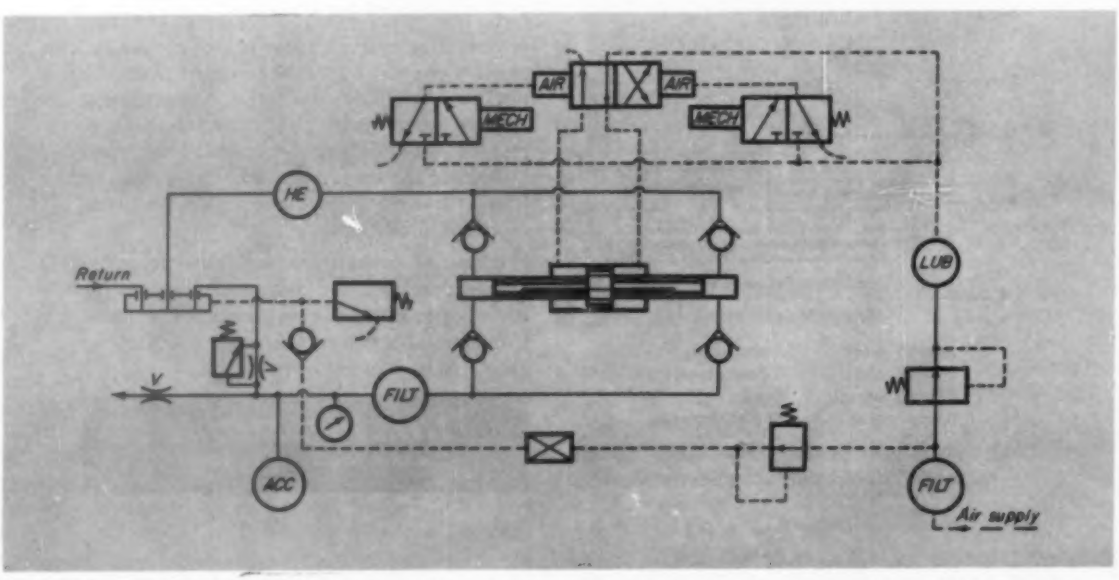
An additional requirement which came up during development was for the unit to fill a system from an external source. A small shut-off valve was added in the pressure line to the reservoir so pressure could be cut off. The unit can transfer fluid by connecting its return line to the external oil supply and its pressure line to the system to be filled. The reservoir level remains constant if the external oil supply is at approximately the same level.

A piston accumulator was installed to smooth out peaks in delivery and to supply additional pressure fluid for instantaneous response to demand. A 10-micron filter in the outlet line protects the hydraulic system. ▼▼▼

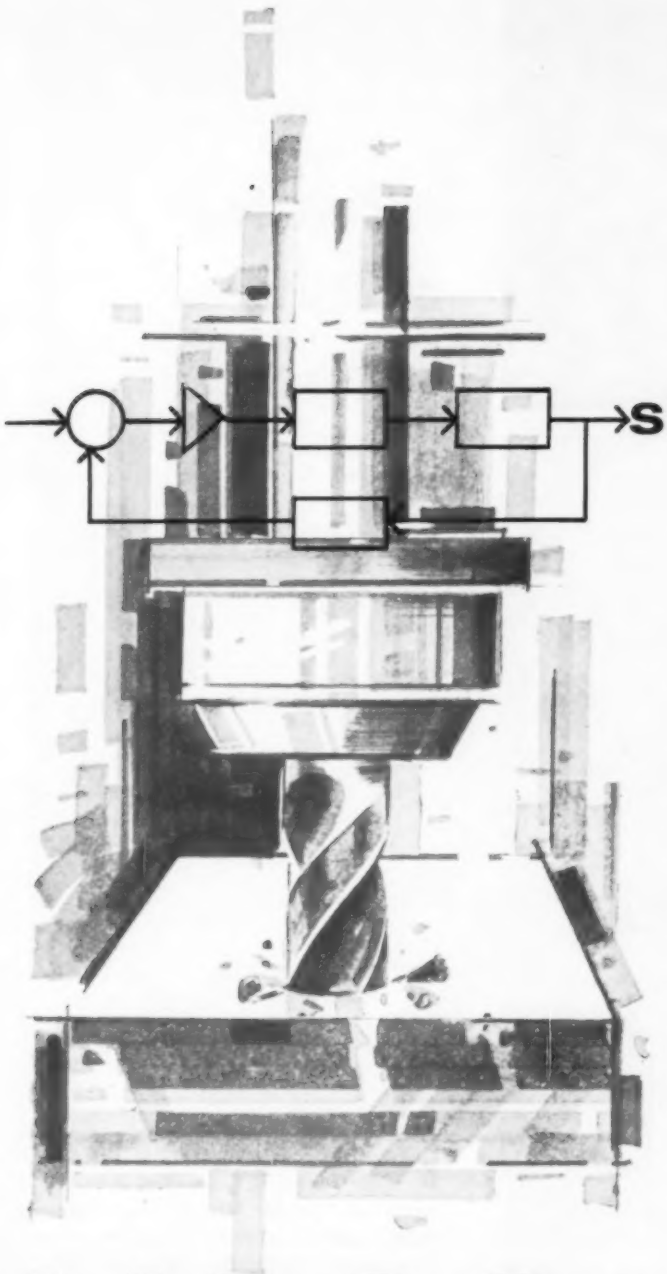
HOW PRESSURE AFFECTS A BOOSTER'S DELIVERY



Delivery from an air-oil booster depends on its stroking speed. This in turn is a function of the difference in forces on it. Driving force *PA* results from regulated air pressure *P* acting on area *A*. Force *pa* which resists the driving force results from load pressure *p* acting on area *a*. The difference between these two forces accelerates the booster and determines its average velocity. Force *pa* cannot be adjusted for a particular work cylinder size and booster ratio. Force *PA* is adjusted by a pressure regulator and also depends on line pressure drop from the regulator to the booster. Reducing this line drop increases driving force and booster delivery.



RECIPROCATING BOOSTER CIRCUIT passes oil from the reservoir through a heat exchanger where it is cooled by expanding exhaust air from the booster.



electrohydraulically speaking...

how accurate, how reliable is a SERVOSYSTEM?

The servovalve is the prime determining factor of reliability and accuracy in a Servoactuation system. In a drive control system which includes servovalves, amplifiers, actuators and necessary power supplies, exceptional valve performance is required. Use of Moog's servovalve and unitized approach to system design insures maximum component performance.

SERIES 71 SERVOVALVE

SERIES 72 SERVOVALVE

comparatively speaking . . .

WHAT ADVANTAGES DO ELECTROHYDRAULIC SERVOSYSTEMS OFFER?

". . . First and foremost, they provide dynamic response capabilities completely out of the range of any other types of control . . . Their range of dynamic response is much higher than the fastest pneumatic system . . .
The next important advantage offered is size and weight . . . the complete hydraulic system for all but the very low horsepower applications is lighter than any other type of powered control system . . .
Third, the systems are rugged. They can operate under severe environmental conditons."*

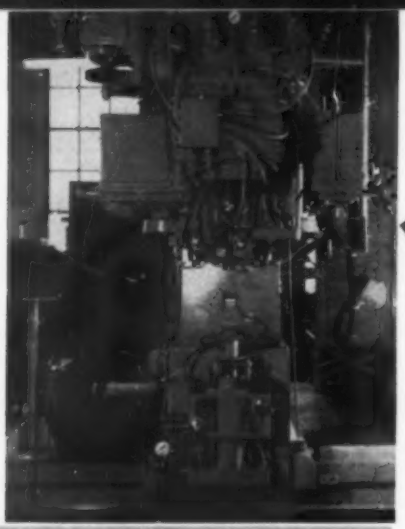
*Bernard A. Johnson NCIH Article 13th Annual Meeting
"The Application of Electro-hydraulic Servo Valves to Industrial Control"

MOOG:

SERVOSYSTEMS IN INDUSTRY

WRITE FOR PB110

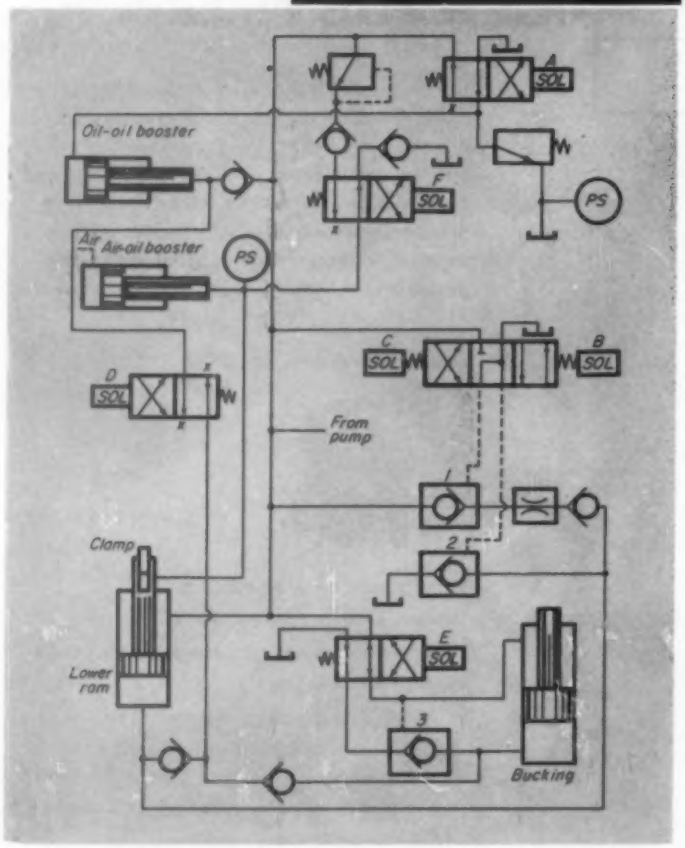
MOOG SERVOCONTROLS, INC. INDUSTRIAL DIVISION EAST AURORA, N. Y.



Riveter circuits speed aircraft assembly

● By J. A. RANDOLPH

General-Electro Mechanical Corp.
Buffalo, New York



PUMP PRESSURE holds the lower ram and bucking cylinder retracted. To start the cycle, solenoid *B* is energized, opening pilot check valve 1 and extending the lower ram with a differential circuit. Lower ram extended de-energizes solenoid *B* which closes pilot check valve 1. Lower ram stops.

Another section of the circuit (not shown) extends the drill, and inserts the rivet slug. To extend the bucking cylinder, a limit switch energizes solenoid *E*. The bucking cylinder extends and energizes solenoids *A* & *D*, to boost pressure in the bucking cylinder and lower ram by directing pump delivery to the oil-to-oil booster. Output from the booster goes to the lower ram and bucking cylinder. Solenoid *F* is also energized and flow through the pressure reducing valve retracts the air-to-oil booster. Air pressure is then applied to the booster which applies high pressure oil to the clamp. When pressure reaches the pressure switch setting, solenoid *D* is energized and oil is trapped in the lower ram.

A timing relay starts a vibrator which upsets the upper rivet head. The relay times out to stop the vibrator, release clamp pressure, and return the lower ram and bucking cylinder. It does this by de-energizing solenoids *E* & *F*, and energizing solenoid *C* which opens pilot check valve 2.

BOTH air and oil powers this automatic riveter at a speed of 8 to 10 rivets per minute. It drills, countersinks, inserts slug (headless rivet), upsets, shaves rivet head flush with the work, and moves automatically to the next drilling position.

The machine has an upper head and a lower ram mounted on a carriage. A fluid motor moves the carriage along tracks parallel with the work. Another fluid motor drives the carriage transversly.

The drill spindle and bucking cylinder with vibrator gun mount on the upper head. An air cylinder moves them into position for drilling and bucking. Shave units, mounted on either side of the head are positioned by hydraulic

interchangeable with all standard JIC cylinders

With the introduction of the ALL NEW T-J Squair Head, Tomkins-Johnson now offers industry the most complete design range of air and hydraulic cylinders. Presently available in bore diameters from 1½ to 8 inches, the T-J Squair Head is an interchangeable cylinder which produces maximum force and efficiency, with minimum pressures . . . and is also adaptable to the use of low pressure oil as the working medium. Write to The Tomkins-Johnson Co., Jackson, Michigan, for Bulletin #SQ 10-58 and complete details.

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5 New Super-Cushion for air, or Self-Aligning Master Seal for Oil (T-J Patents)

6 Solid Steel Heads and Mounting Plates Standard all Models

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9 Piloted Packing Gland—Absolute Alignment

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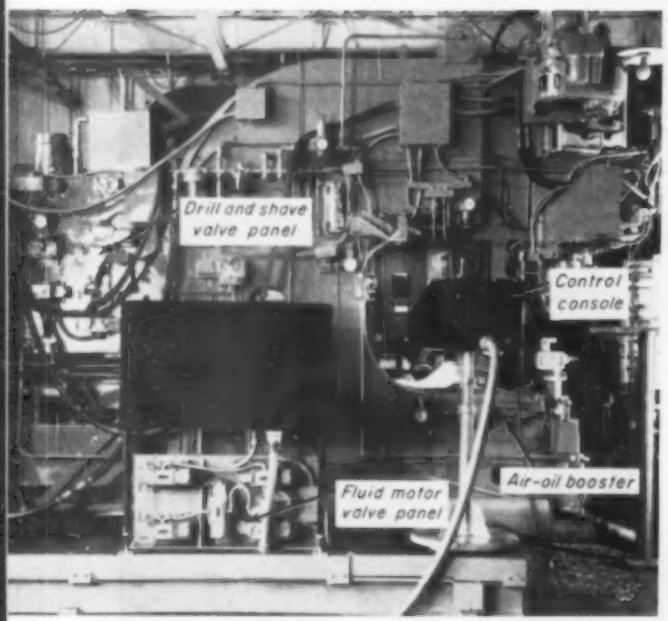
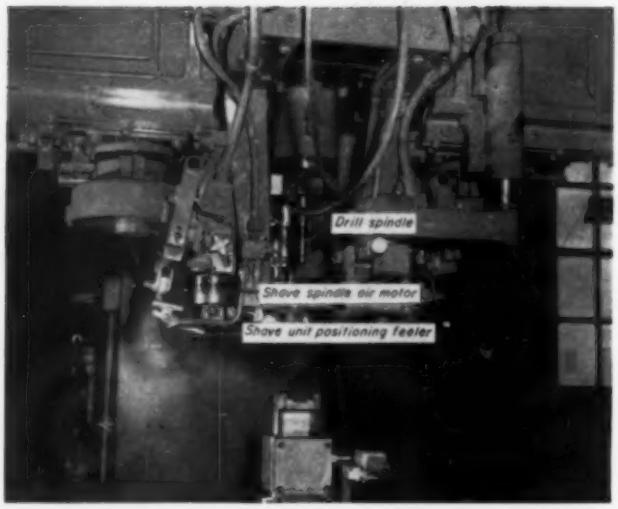
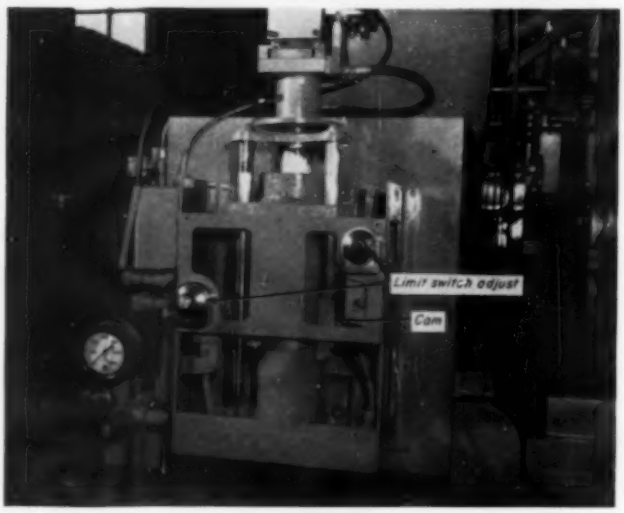


CONTROL CONSOLE mounts on a pedestal and moves along the rails with the riveter. It contains a punched tape which programs all functions of the machine. Clamp pressure is controlled by regulating air pressure to air-oil booster.



DRILL AND SHAVE units mount on the machine's upper carriage. An air motor drives the shave spindle at a constant speed of 7000 rpm. Feelers, moving with the carriage along the surface of the work, locate the rivet and position the shave unit directly above it. When the drill extends, the shave unit extends with it.



TAPERED CAM actuates a limit switch as the lower ram extends. Actuation point is controlled by rotating the vernier dials which move the limit switch in and out.

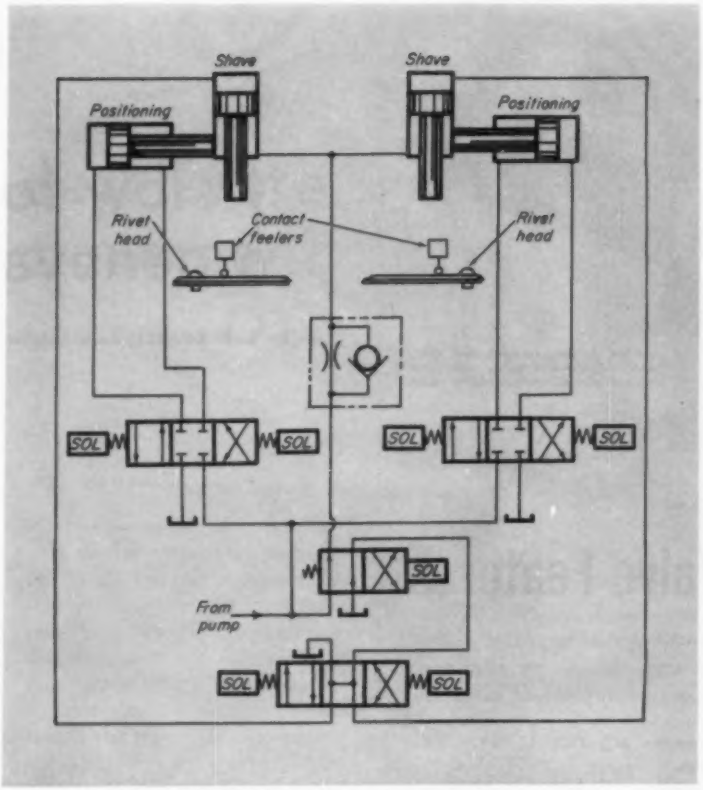
cylinders. As the machine moves along the work, the upset head of the slug contacts feelers mounted on the shave spindles. When the machine stops at the next slug to be riveted, the shaver head "homes," centering the shave cutter on the slug head to be shaved. When the drill head extends, the shaver also comes down.

The lower ram is a hydraulic cylinder with an auxiliary hydraulic cylinder for clamping the work.

• **Operation**—At the signal to start, the lower ram moves up and clamps the work between a pressure foot on top and a lower anvil clamp. The drill extends rapidly. When it reaches the work, a deceleration valve diverts flow from the cylinder through a flow control valve to regulate drill and countersink feed. A positive stop limits countersink depth. A pressure switch in the drill cylinder return line shifts its control valve to retract the drill.

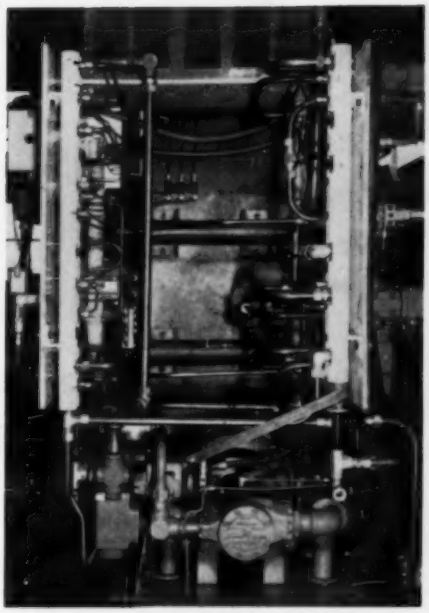
After drilling, a limit switch actuates a control valve to transfer the head to riveting position. The bucking cylinder extends, inserting a slug in the drilled hole. A booster intensifies oil pressure in the bucking cylinder and lower ram, swaging the lower head of the rivet. At a set pressure, a pressure switch shifts a control valve, locking oil in the lower ram.

A timer-controlled vibrator then upsets the upper head in the countersunk hole. The timer times out to return upper and lower ram and unclamp work. When the bucking cylinder retracts, a limit switch transfers the head to drill position, ready for the next cycle. ▼▼▼

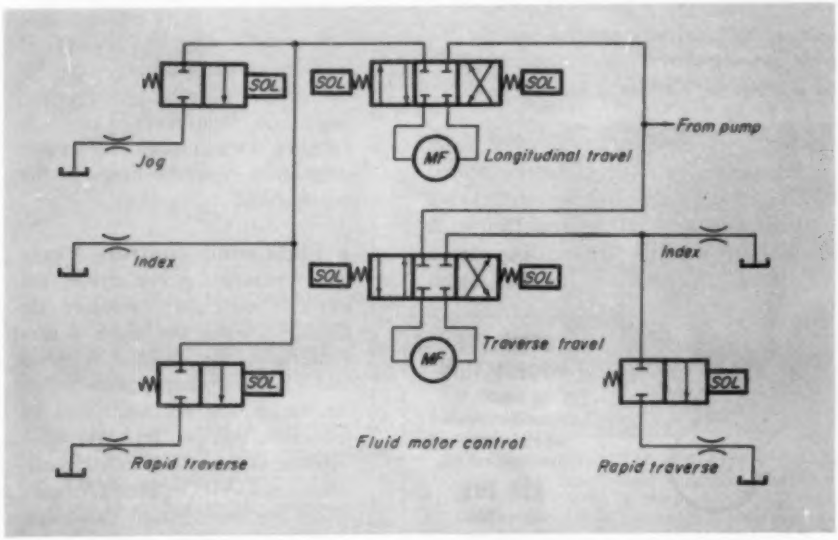


POSITIONING CYLINDERS locate the shave cylinders over the head of the rivet to be shaved. Limit switch feelers move along the surface of the work as the riveter indexes. When they strike the protruding head of a rivet, the contacts close and actuate one of the solenoids on the corresponding positioning cylinder control valve. The shaver head transfers until the cutter is over the rivet to be shaved. When the drill spindle extends to drill the next hole, shaver extends with it.

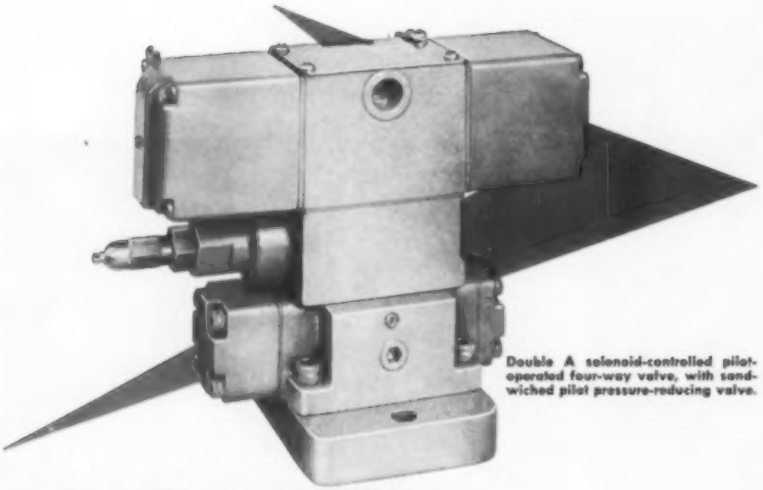
Shave cylinders are held up by pump pressure. To extend either of the cylinders, the 2-position, 4-way valve shifts and directs pump delivery to the 3-position solenoid valve. Either shave cylinder can then be extended by energizing one of the solenoids on its 3-position valve.



CONTROL VALVES for drill, shave, clamping, and bucking, are on panels mounted back-to-back. Grouping the control valves makes maintenance simple and keeps pump-to-valve lines short. A vane pump, mounted on the reservoir powers the circuit. An air-to-oil heat exchanger mounted above the panel cools the hydraulic fluid.



A FLUID MOTOR drives the machine carriage along a set of tracks paralleling the work. Another fluid motor moves the carriage transversely. Speed is controlled by metering-out through flow control valves. Carriage moves at the *index* speed during normal operation. *Rapid traverse* and *jog* speed are for setup.



Double A solenoid-controlled pilot-operated four-way valve, with sandwiched pilot pressure-reducing valve.

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- Fifteen different standard cataloged main valve spool types are available, to accurately match your demands.
- Two kinds of sub-plates, the usual back-entering plus the back-and-side entering type, are offered.
- SAE straight thread openings are optional at no extra cost.

See for yourself how much more Double A valves offer, from the sensible flow ratings (based on *minimum* pressure drops) right down to the extra mounting bolts (to prevent O-ring troubles under high pressures). Contact your nearest Double A hydraulic distributor. Or write to **Double A Products Co.**, a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

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Circle **29** on Time-Saver Card

How to a geneva

• By S. BAKEWELL, *Leland-Detroit*

INDEXING a 3-ton work table with a fluid-motor driven, geneva movement requires close control of fluid motor speed. The motor *accelerates* the table gradually, but inertia of the rotating table overruns the fluid motor and makes it difficult to decelerate.

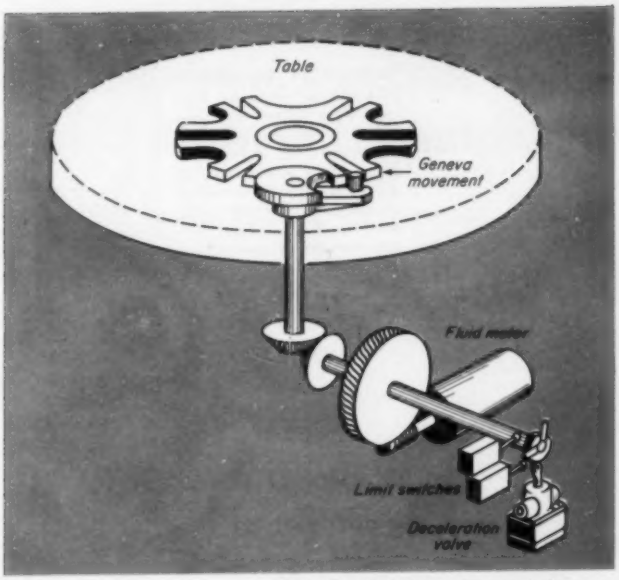
A pressure-compensated flow control valve in the motor's discharge line would keep the motor at constant speed, but, engineers at Detroit-Leland needed a slower table deceleration than they could get by rotating the geneva movement at constant motor speed. A cam-operated deceleration valve placed in the fluid motor's discharge line gives them full control over deceleration.

The work table is on a 6-station, rotary indexing machine which assembles eight valves into automobile engine heads. The heads feed into the machine from a transfer conveyor. Hydraulic cylinders position and clamp them in place. A rotating cam pushes the valve stems into guide bushings in the engine head.

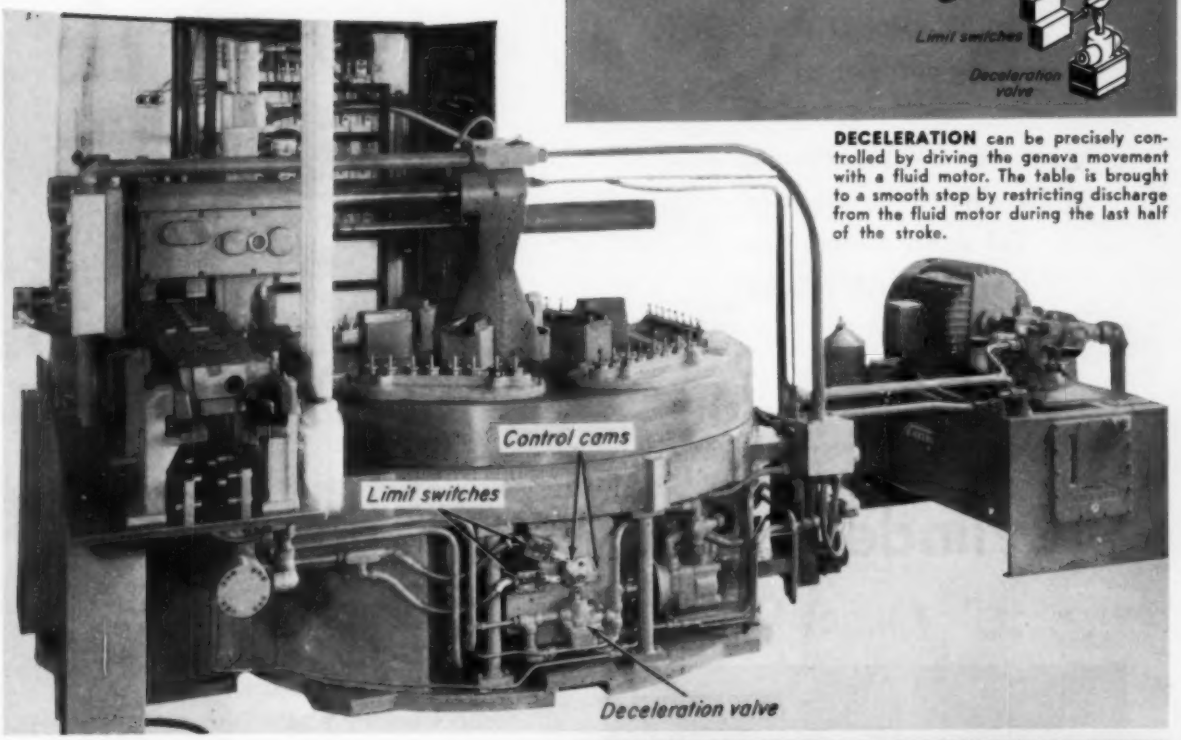
• **Fluid motor control**—A vane type hydraulic motor drives the geneva indexing mechanism through a worm and wheel. A cam rotating on the wheel shaft opens and closes a deceleration valve. Acceleration is not controlled by the valve, because the heavy table accelerates smoothly to its maximum velocity. The cam gradually closes the deceleration valve during the last half of the stroke,

decelerate movement

Manufacturing Co., Detroit, Michigan

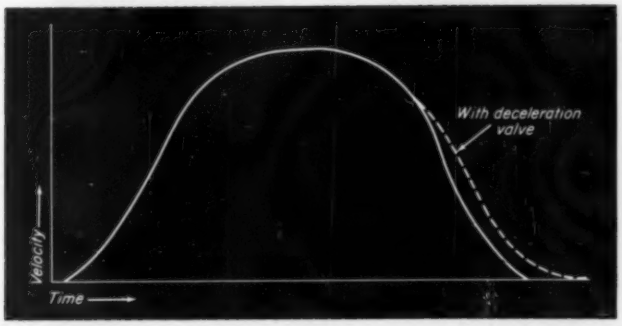


DECELERATION can be precisely controlled by driving the geneva movement with a fluid motor. The table is brought to a smooth stop by restricting discharge from the fluid motor during the last half of the stroke.



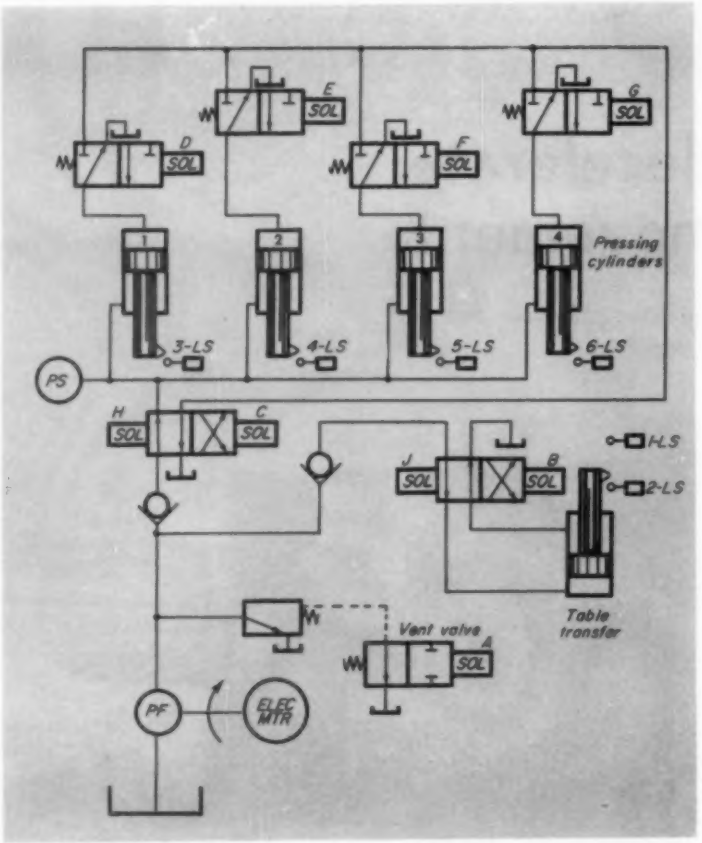
braking the fluid motor and bringing the table to a smooth stop. Deceleration can be increased or decreased by altering the cam's shape.

Two additional cams rotate with the wheel shaft. They actuate limit switches to assure that the tools are clear before the machine indexes. ▼▼▼



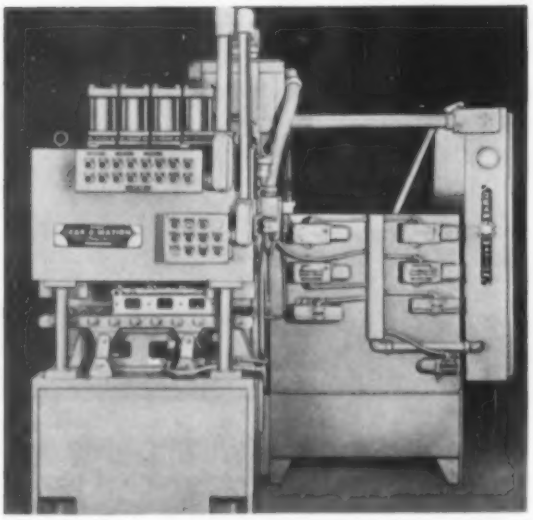
VELOCITY of a geneva movement at no load and driven at constant input speed is indicated by the solid line. Deceleration at the end of the stroke is rapid. Velocity is highest at the midpoint of the stroke. The dotted line shows the gradual reduction in velocity of a geneva movement decelerated during the last half of its stroke.

THREE-WAY SOLENOID VALVES actuated by timing relays extend the cylinders in succession. This permits using a smaller pump than would be required if they all extended at once. One 4-way valve retracts all cylinders. The pressure switch senses that all cylinders are retracted.



Four cylinders extend during one operation of this machine. Power requirements are kept low by extending the cylinders in sequence. Full pump delivery then extends each cylinder.

Cylinder sequencing saves power



• By **RICHARD S. HILDRETH,**
Chief Engineer, Michigan Tool Co., Detroit, Mich.

A PRIMARY concern in designing hydraulic machines is keeping the peak work load low so that a small hydraulic power unit can be used.

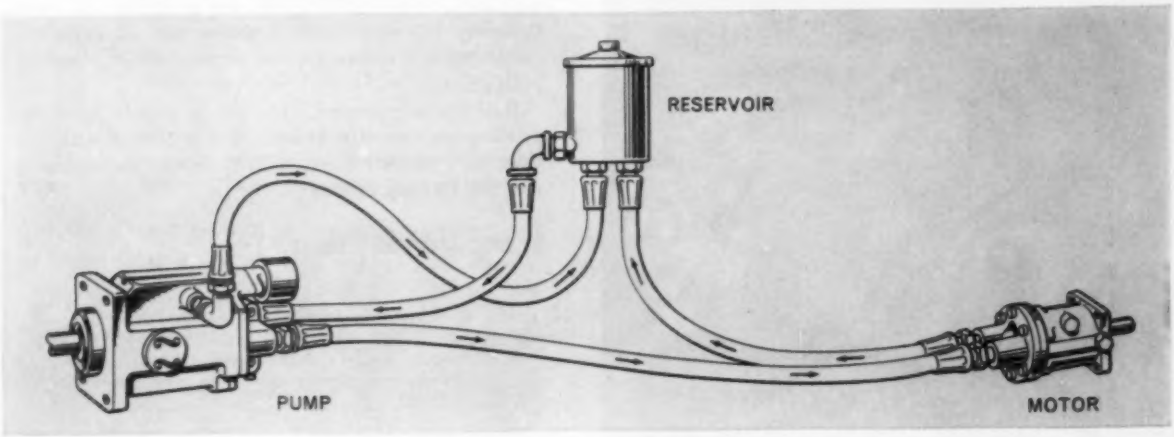
This machine has four cylinders which press valve guides into diesel engine cylinder heads. Power requirements are low because only one cylinder extends at a time. Electrical timing relays and limit switches control the sequence.

A cylinder head, with bushings held in place by a pilot plate, feeds into the machine from a roller conveyor. It is located by a cylinder-operated end stop

Creative hydraulics by Sundstrand

Variable input—constant output speed transmissions designed for mobile equipment

Compact, lightweight, highly efficient hydrostatic transmissions develop up to 9 hp



32 PV Variable Displacement Pump

Reservoir 1½-Quart Capacity

7MC Fixed Displacement Motor

Here's a new idea in boosting efficiency of constant output speed auxiliary operations on mobile equipment. Compact, high-efficiency hydrostatic transmissions designed to use low-cost piston-type pumps and motors are being introduced in six standard sizes by Sundstrand—a company with more than 10 years' experience in constant speed drives.

Principal components of the Sundstrand hydrostatic transmission as shown at the left are: (1) Variable displacement axial piston pump, (2) a fixed displacement axial piston motor, and (3) a small (1½-quart) reservoir. Output horsepower depends on input speed range (see table at right).

Motor speed remains constant within ± 5% despite variations in pump input speed because of the unique control. The pump continually measures its own output and makes adjustments automatically in order to deliver a constant flow of oil.

By adding a small independent manual control to the circuit, pump delivery may be regulated to vary output speed of the motor from zero to maximum RPM. Constant motor output speed is maintained at any particular valve setting.

System is unusually compact and light in weight. There's no spilling of oil over a relief valve or bypassing of oil under pressure as pump delivers only the amount of oil needed. High efficiency is obtained —therefore there is no problem of heat dissipation.

Typical Hydrostatic Transmissions

OUTPUT H.P.	PUMP INPUT SPEED RANGE—RPM	MOTOR CONSTANT OUTPUT SPEED RPM ± 5%*
2 hp	300 to 3000	1200
3 hp	450 to 3000	1800
4 hp	600 to 2500	2400
6 hp	800 to 2400	3000
8 hp	850 to 2300	3300
9 hp	950 to 2200	3600

*Under normal rated load conditions, motor output speed can be held constant within ±5%.

Typical applications for Sundstrand hydrostatic transmissions include: Alternator drives on construction and fire-fighting equipment, refrigeration compressor drives, fan drives in air conditioned buses, and conveyor drives on agricultural, construction and mining equipment.

Sundstrand hydrostatic transmissions can be the answer to your power requirements. Get more facts by sending a brief outline of your needs to address below.

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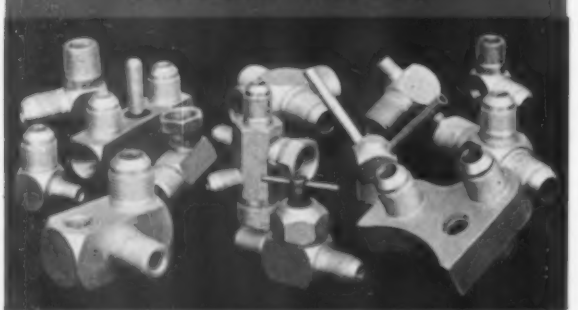

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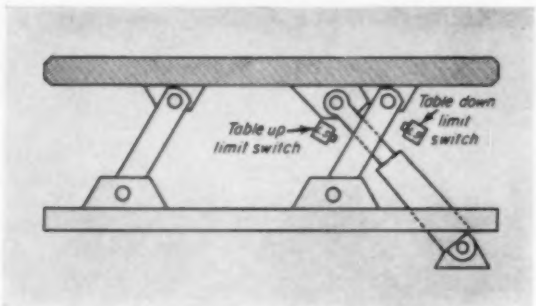
CYLINDER SEQUENCING SAVES POWER

and lowered to press position. A limit switch, actuated when the table reaches press position, extends the first cylinder.

Each cylinder actuates a limit switch when it extends fully. Each limit switch starts a dwell timer to insure full seating of the guide and to extend the next cylinder. A pressure switch senses that all cylinders have retracted, and returns the work table to unloading position.

Bushings are pressed with 850 to 1300-lb force depending on their size. If a bushing is pressed with less than the required force, a light signals the operator that the bushing is loose. ▼▼▼

This machine was designed by Michigan Tool Co. and built by its Gear-O-Mation Division.



DOUBLE-ACTING HYDRAULIC CYLINDER raises and lowers the work table through a parallel linkage. Limit switches, actuated by a bar in the linkage, signal when the work table is fully raised or lowered.

OPERATION	LIMIT SWITCHES 1	2	3	4	5	6
Table up, cylinders up	■					
Press start buttons						
Work table down		■				
Cylinder 1 down		■	■			
Cylinder 1 dwell completed		■	■			
Cylinder 2 down		■	■	■		
Cylinder 2 dwell completed		■	■	■		
Cylinder 3 down		■	■	■	■	
Cylinder 3 dwell completed		■	■	■	■	
Cylinder 4 down		■	■	■	■	■
Cylinder 4 dwell completed		■	■	■	■	■
All cylinders returned		■				
Table up	■					

ELECTRICAL SEQUENCE

1. Pressing both START buttons energizes relays 1 & 2 and solenoids *A* and *B*. Venting valve closes and table lowers.

2. Table down actuates limit switch 2 energizing relays 3 & 4 and solenoids *C* & *D*.

3. Cylinder 1 extends and actuates limit switch 3 energizing dwell timer 1-T.*

4. Timer 1-T times out de-energize solenoid *D* and energize solenoid *E*. This connects the head end of cylinder 1 to tank, and extends cylinder 2.

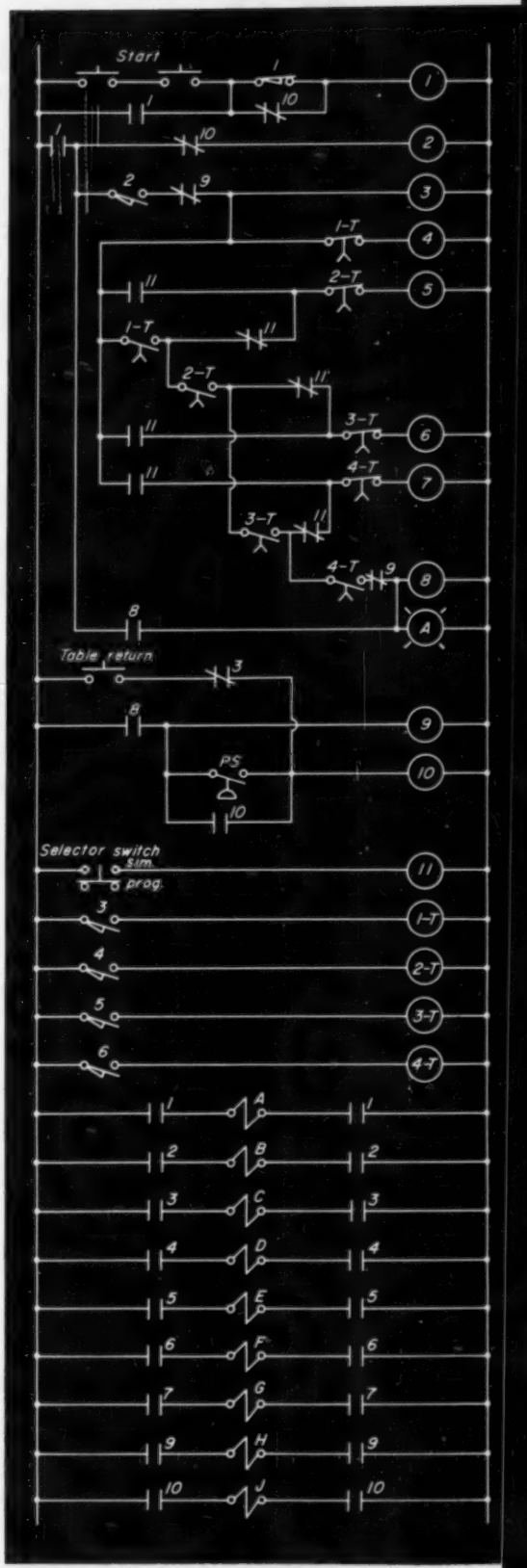
5. The cylinders extend and dwell in sequence, energizing timers 2-T, 3-T, and 4-T.

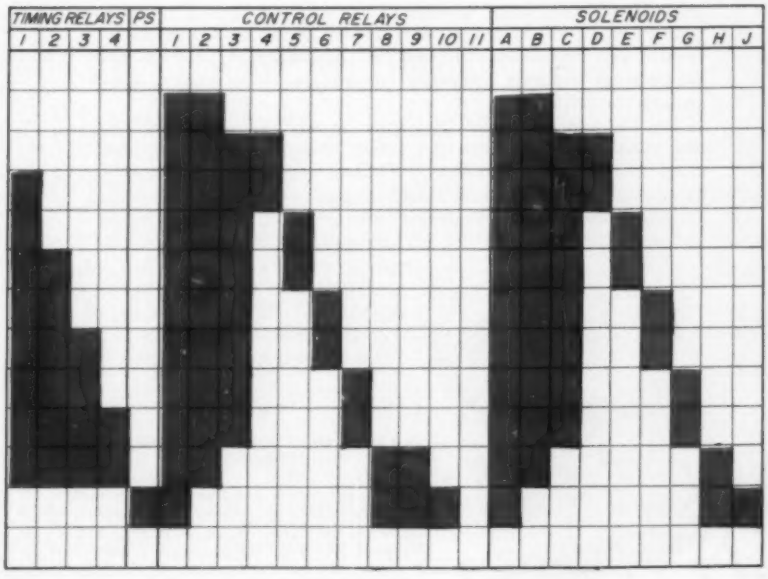
6. 4-T times out to energize relay 8 which lights an amber light (indicates all cylinders down); and energizes relay 9 to actuate solenoid *H*, retracting all cylinders.

7. Cylinders' return actuates pressure switch *PS*, energizing solenoid *J*.

8. Table raises and actuates limit switch 1, de-energizing solenoid *A* which opens the venting valve.

* If the selector switch is on SIMULTANEOUS, relay 11 is energized and all cylinders extend when limit switch 2 is actuated.





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SOLENOID VALVES

Small solenoid valves that Fill a BIG order

Yes, a series of small, direct acting solenoid valves that fulfill today's critical requirements for rugged, positive-acting tight-seating valves in types, patterns, orifice sizes and electrical ratings for use on a particularly wide variety of media including air, water, petroleum products, coolant, oxygen, hydrogen and acetylene.

They are new only in the production sense. Actually this announcement was preceded by long development and research which drew on more than 90 years of experience in instrument and valve making.

The net result is a valve that combines instrument-precision with the ruggedness that distinguishes all Marsh Valve Specialties!

Despite their small size, "Master-mite" Solenoid Valves are more rugged because the "beef" is where it counts—in the valve body. The generous, moisture-resistant coils do not overheat. Entire assembly is leak-tight at pressures up to 540 psi. Operation is positive . . . yet quiet. Valves can be cleaned without breaking connections . . . can be used in any position.

Bodies are available in either brass bar stock or 18-8 stainless steel. All parts in contact with media are stainless steel. Down to the last detail, "Master-mite" solenoid valves are designed and built to stand up and work right under the toughest conditions including vibration. They are Underwriters' approved for use on oxygen and hydrogen and as safety valves.

Read the accompanying specifications. Note the wide range of selection. Ask for bulletin containing all details.

Note these specifications

★ **Types:**	Direct acting conduit type and grommet type. Four patterns of each size and type: globe, bottom outlet, angle left, and angle right.
★ **Sizes:**	⅛" and ¼" NPT.
★ **Pressures:**	From vacuum to 540 psi. maximum.
★ **Orifice sizes:**	Ten sizes: 3/64", 1/16", 5/64", 3/32", 7/64", 1/8", 9/64", 5/32", 3/16", 1/4".
★ **Voltages:**	Standard with 115 volts 50/60 cycle AC coils, but also available in 12, 24, 208, 230 and 460V, 50/60 cycle coils.
★ **Leads:**	Standard with 18", but other lengths available; also full range of connectors.
★ **Body:**	Brass bar stock or 18-8 stainless steel.
★ **Moving parts:**	All stainless steel.
★ **Seat disc:**	Synthetic rubber.
★ **Approved by Underwriters' Laboratories as a safety valve.**	

New bulletin tells the whole story

Shows all types, patterns, sizes, coils, options, etc., and contains highly useful flow curves.

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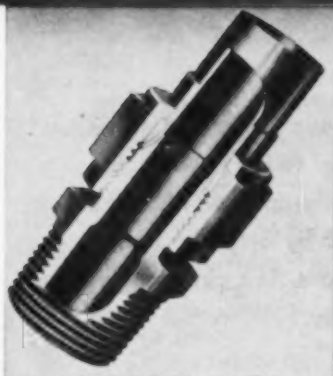

37° FLARED "J.I.C."

FLARED TUBE FITTINGS and PIPE FITTINGS

J 815 TUBE UNION

J 815-X-X REDUCER UNION

J 816 MALE CONNECTOR

J 854 FEMALE CONNECTOR

J 821 TUBE ELBOW

J 822 MALE ELBOW

J 877 LONG MALE ELBOW

J 878 EXTRA LONG MALE ELBOW

J 823 MALE ELBOW 45°

J 855 FEMALE ELBOW

J 824 TUBE TEE

J 825 MALE SIDE TEE

J 826 MALE RUN TEE

J 856 FEMALE SIDE TEE

J 857 FEMALE RUN TEE

J 827 TUBE CROSS

J 832 BULKHEAD UNION

J 833 BULKHEAD ELBOW

J 834 BULKHEAD TEE

J 837 45° BULKHEAD ELBOW

J 806 TUBE PLUG – FLARED

J 860 TUBE END REDUCER

J 818 TUBE NUT

J 819 TUBE SLEEVE

J 820 TUBE CAP – FLARED

J 924 BULKHEAD LOCKNUT

910 PIPE CONNECTOR

911 PIPE NIPPLE

912 REDUCING BUSHING

913 SQUARE HEAD PLUG

914 90° STREET ELBOW

915 45° STREET ELBOW

916 PIPE ELBOW

917 PIPE TEE

918 PIPE CROSS

932 HOLLOW HEX PLUG

933 HEX HEAD PLUG

840 HOSE NIPPLE

FLARELESS TUBE FITTINGS

F 815 TUBE UNION

F 815-X-X TUBE UNION REDUCER

842 90° HOSE ELBOW

844 45° HOSE ELBOW

F 816 MALE CONNECTOR

F 854 FEMALE CONNECTOR

F 821 TUBE UNION ELBOW

F 822 90° MALE ELBOW

F 823 45° MALE ELBOW

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F 860 TUBE END REDUCER

F 818 TUBE NUT

F 819 TUBE SLEEVE

F 924 BULKHEAD LOCKNUT

F 929 TUBE CAP

F 806 TUBE PLUG

FLARELESS

AFCO FITTING CO.

5300 Harvard Avenue Cleveland 5, Ohio

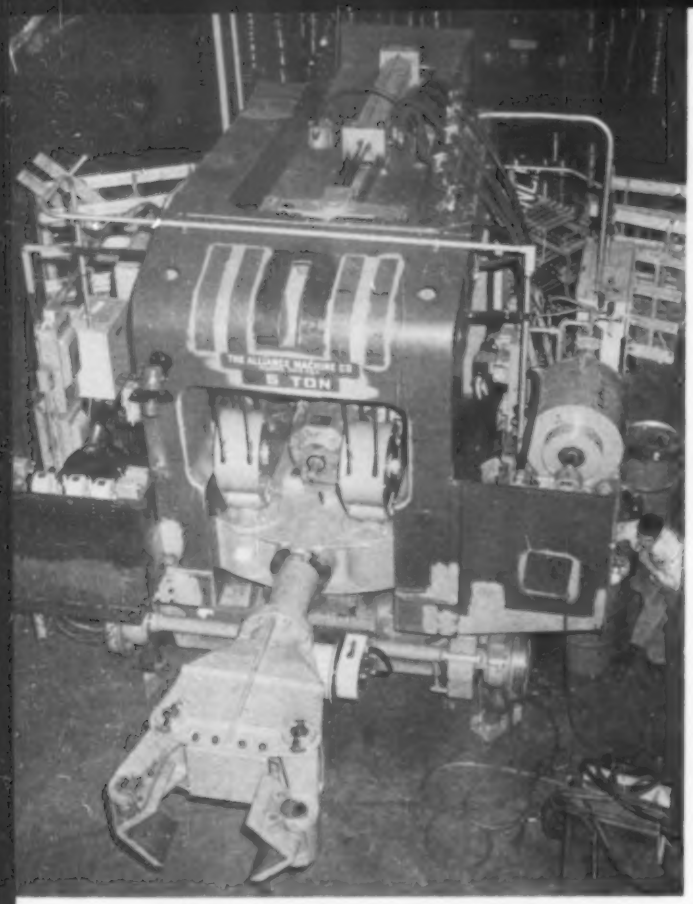
SEND FOR CATALOG ON THE COMPLETE LINE OF – AFCO INDUSTRIAL FITTINGS

Hi-lo circuit

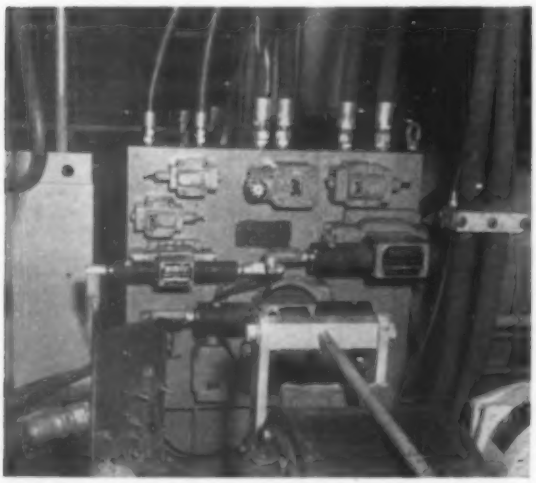
• By **ARTHUR ALBEREGG,** *Assistant*
and DONALD R. HARTER, *District*

To close a 7½-inch gripper cylinder fast, three pumping cartridges deliver to it. However, the gripper requires only make-up flow while it's clamped, so it's supplied by only one of the pumps' low volume sections. The circuit gives both efficiency and safety.

A VARIATION of the efficient hi-lo circuit is used on a large manipulator designed by Alliance Machine. While the gripper is clamped by low volume high pressure from one of the pump's small sections, the two large sections can deliver independently to the hoisting and leveling cylinders, or they unload back to the tank at low pressure through tandem-cen-



FRONT HOIST CYLINDER mounts horizontally on top of the manipulator. It raises and lowers the front of the carriage through cables. Leveling cylinders raise and lower the rear carriage mount.



VALVES ARE MOUNTED on a drilled panel above the hydraulic power unit. They are easy to get to, and can be removed without disturbing the piping. This panel mounting eliminates pipe joints and reduces leaks.

CIRCUIT DESIGN POINTERS

1 SHOCK PREVENTION—Fast starts and stops can cause severe shock when you move a 5-ton forging. This circuit uses three methods of controlling the valve spools to prevent shock: 1. It supplies low pressure (75 psi) to the valve pilots. 2. Restrictions are used in the lines to pilot valves. 3. Pilot chokes are used on the control valves.

2 SPEED CONTROL AND SYNCHRONIZING CYLINDERS—Two, pressure-compensated, variable orifice flow control valves regulate speed and synchronization by bleeding off oil from the large volume pumps. The bleed-off oil does not go directly to tank. It returns to the circuit downstream of the front hoist and rear leveling 4-way valves. Here it combines with oil flowing through the valves. Total pump volume is always available to move the gripping cylinder fast.

3 EFFICIENCY—Tandem 4-way valves and the unloading valve permit the entire output from both hi-volume pump sections to unload to tank after passing through the valves. Only the low-volume pump sections operate at relief valve setting.

4 TEMPERATURE REGULATION—Very little input energy is lost in heat. Both high volume pumps unload at a very low pressure through the unloading valve, except when they are operating the cylinders. The only pump delivering continuously at high pressure is the small (2½-gpm) pump holding the gripping jaws tight. With the gripping jaws held open, this pump relieves at 250 psi.

with two double pumps

Chief Engineer, The Alliance Machine Co., Alliance, Ohio
Sales Manager, Vickers Incorporated, Div. Sperry-Rand Corporation, Houston, Texas

ter, 4-way valves, and an unloading valve which is held open by clamp pressure.

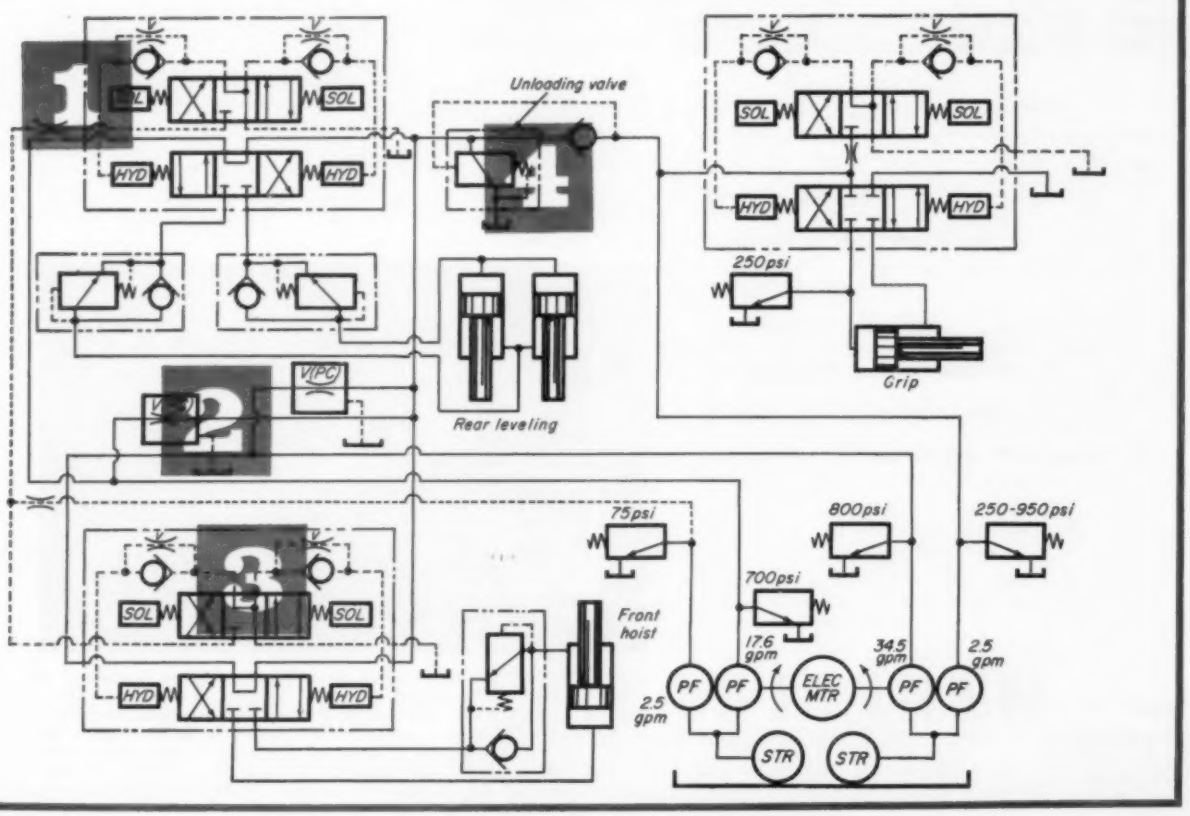
Two double pumps power the circuit. The low volume of one pump section supplies external pilot pressure oil at 75 psi to the 4-way valves controlling the lift and leveling cylinders. Constant volume pilot pressure together with restrictions and pilot chokes control shifting of the valve spools to eliminate shock in the system.

The low volume output from the other pump supplies oil to the gripping cylinder while the high-volume pumps are unloading. This assures full pressure on the gripping cylinder regardless of the demands of the lift and leveling cylinders.

A check valve and an unloading valve isolate the gripping cylinder circuit from the main circuit. When the 4-way valve controlling the gripping cylinder shifts, oil from both high volume pumps combines with oil from the low volume pump to extend the gripping cylinder. When pressure builds up in the gripping cylinder, it actuates the unloading valve which opens the discharge line from the control valves to tank.

• **Counterbalancing the cylinders**—A counterbalance valve in the front hoist cylinder line prevents the cylinder from running ahead of the pump volume on lowering. The rear leveling cylinders use counterbalance valves for the same reason. The force tending to move the cylinders can be in either direction.

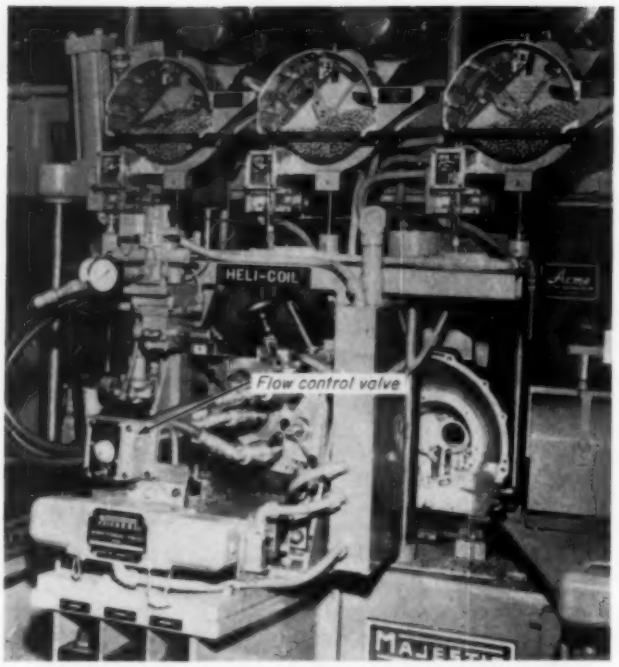
Bleed-off flow control valves vary overall speed of cylinders and synchronize vertical movement of the the hoist with the leveling cylinders. Bleed-off oil returns to the circuit ahead of the unloading valve. When the grip cylinder is operated, full pump delivery is still available to provide fast gripping. ▼▼▼



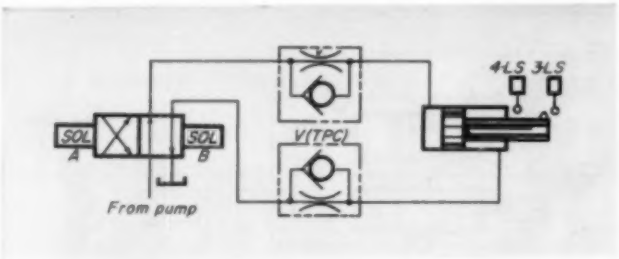
Viscosity changes don't change our feed rates

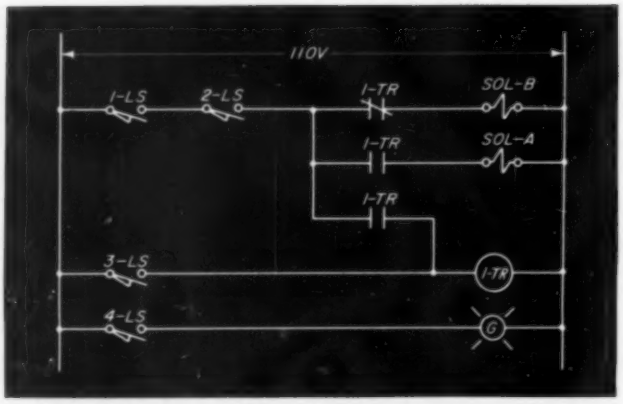
• By T. B. EDDY,
Development Manager
Heli-Coil Corporation
Danbury, Conn.

Speed control is an important advantage of hydraulics for assembly operations. A temperature compensated, flow control valve insures constant speed on this machine.



PRESSURE AND TEMPERATURE-COMPENSATED FLOW CONTROL VALVE gives constant tool feed with varying oil viscosity on this assembly machine. The valve meters oil out of the rod end as the cylinder extends. Cylinder speed is accurate within 1%.





LIMIT SWITCHES 1-LS and 2-LS close when the casting is clamped in place. Solenoid B is energized, extending the tool feed cylinders. When the tool carriage is fully extended, it actuates 3-LS energizing time delay relay 1-TR which delays 5 seconds for the inserts to be installed to full depth. Relay 1-TR times out to de-energize solenoid B and energize solenoid A, retracting the tool carriage. The tool carriage fully retracted actuates limit switch 4-LS, signalling that the station is ready for transfer.

WHEN installing wire, thread inserts in a casting, feed rates must be exact. For consistent feed rates, design engineers at Heli-Coil use temperature and pressure-compensated, flow control valves on their feed cylinders.

The machine has two stations: one loads, aligns, and installs three wire thread inserts, the second breaks off the driving tang.

• **Cylinder speed controls**—A short stroke hydraulic cylinder extends and retracts the carriage-mounted inserting tools. A flow control valve is installed in the line from the rod end of the cylinder and regulates speed by metering-out.

Threaded holes in non-ferrous castings often require a greater thread loading than aluminum or magnesium will stand. Stainless steel wire thread inserts give the threaded assembly considerably more holding force. This machine installs three threaded inserts in automotive transmission housings.

A non-compensated flow control valve was first tried on the machine. It was not accurate enough because of the large viscosity change in the hydraulic oil as the machine warms up. Oil temperature varies from 70 F to 150 F. The pressure and temperature-compensated flow control valve holds the cylinder speed accurate within 1%. A non-compensated, in-line, flow control valve regulates cylinder return because this speed is not critical. ▼▼▼

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312:

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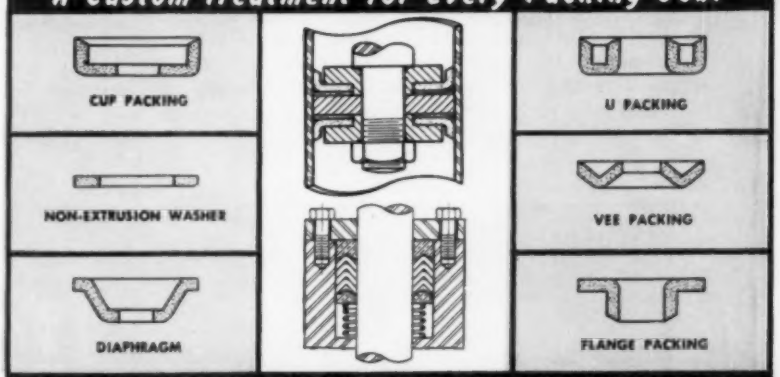

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Makes very fine cups, vees, "U" packings, flange packings and non-extrusion back-up washers.

312: Has a synthetic impregnated into the thermo leather, one of the first developed by Marsh. It is the accepted standard in many hydraulic and pneumatic installations. Its temperature range is satisfactory for most standard applications. This utility treatment makes fine cups, flange packings and "U" packings. It is a resilient but firm packing. Used for air, oil and water service.

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Pressure is developed *within hollow pistons* that are completely surrounded by high pressure lubrication. The higher the pressure, the tighter the seal between the moving piston, cylinder sleeve and pump body, offering greater efficiencies to high pressure systems.

FEATURES

- **CHECK VALVES** — positive acting. Action of piston helps seat suction check valves quickly and positively. These valves seal high pressure with the highest efficiency known in hydraulics.
- **PISTONS** — partially hydraulically balanced by high pressure fluid ported to the foot of the piston reducing wear to a minimum, hollow design with walls that taper to a thin edged section which is capable of expanding against the cylinder wall as pressure is developed inside the pistons. This feature allows greater clearances, thus reducing scored piston wall possibilities.

MODEL 20 — Pressures up to 10,000 psi, rated [illegible] gpm at recommended drive speed of 1800 rpm. Minimum drive speed 100 rpm — maximum 3600 rpm. Seven pistons per pump.

MODEL 80 — Pressures up to 10,000 psi, rated [illegible] gpm at recommended drive speed of 1800 rpm. Minimum drive speed 100 rpm — maximum 1800 rpm. Seven pistons per pump.

This unique hydraulic pump feature provides one or more isolated or grouped flow outputs from a single RACINE-SECO piston type pump. Each piston has its own suction and discharge check valves. A seven piston pump consists of seven separate efficient sources of fluid power with a common suction line and with discharge ports connected together as required.

RACINE-SECO® LINE

MODEL C4 — Pressures up to 6000 psi, rated flow 20 gpm at recommended drive speed of 1200 rpm. Minimum drive speed 100 rpm — maximum 1800 rpm. Seven pistons per pump.

MODEL C11 — Pressures up to 10,000 psi, rated flow 11 gpm at recommended drive speed of 1200 rpm. Minimum drive speed 100 rpm — maximum 1800 rpm. Fourteen pistons per pump.

MODEL C5 (not illustrated) — Pressures up to 10,000 psi, rated flow 7 gpm at recommended drive speed of 1200 rpm. Minimum drive speed 100 rpm — maximum 1800 rpm. Fourteen pistons per pump.

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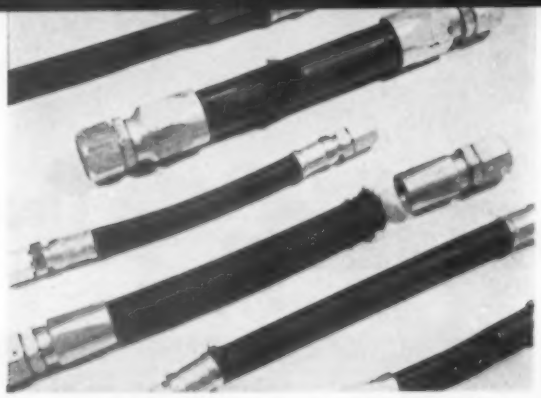
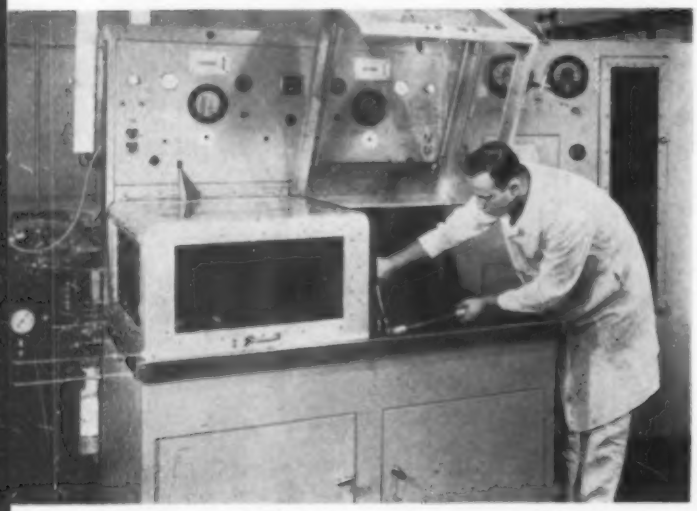
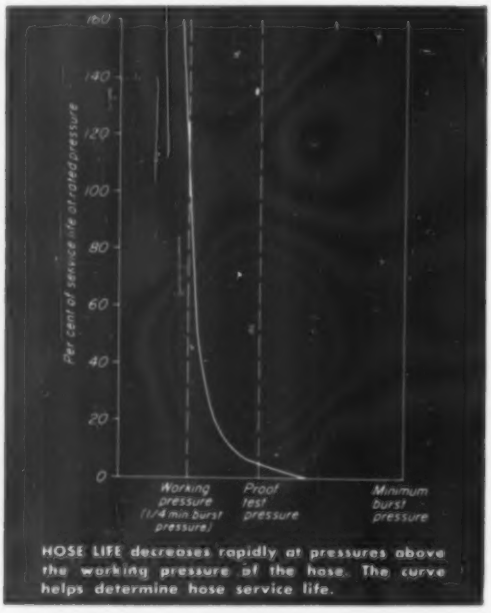


IMPULSING AT 5000 PSI shortened test time for these hose assemblies. Some failed at the end fittings, others blew out through the wire braid.



TEST STAND for impulse testing operates at 5000 psi with peaks to 7500 psi. Using pressures higher than the working pressure of the hose accelerates the tests.



HOSE LIFE decreases rapidly at pressures above the working pressure of the hose. The curve helps determine hose service life.

Will hydraulic hose with the highest burst pressure rating give the longest service? Not always. Many methods are used to test hose and assemblies. An important test for one service may have little value for another.

What hose tests

• By **R. W. PHILLIPS,** *Staff Engineer, Parker Fittings & Hose Div.,*

BURST TESTING is one of the oldest methods of rating hose. In addition to testing hose strength, it also shows whether the end fittings will blow off under pressure. A comparison of hose assembly performance can be made. Equipment for burst testing is simple and can be used by anyone. Results from one test apparatus to another vary only slightly, so it is easy to get basic agreement.

Generally a high burst hose gives better performance, but other factors should also be considered. Hose with only high burst strength may fail earlier than hose with a lower burst, particularly where surge pressures are high. Surge pressures tend to destroy the braid in the hose.

• **Tensile testing**—This shows whether end fittings will pull off. Sometimes end fittings with a lower tensile strength out-perform those with a higher tensile strength. This test is important only if a hose assembly is used for towing, or if it is connected so there is a strain on the fittings.

• **Vibration testing**—Vibration may be applied with pressure or temperature on the hose assembly. Various test fixtures are used, from simple oscillating devices to those which actually pull the hose against the coupling in an effort to cause failure. This type of testing is now applied primarily to metal hose, and some aircraft hose used under severe conditions of pressure and flexing where reliability is very important.

• **Impulse Testing**—Many improvements in hose

mean to you

Parker-Hannifin Corp., Cleveland, Ohio

construction have resulted from impulse testing. It was originated to eliminate unsatisfactory hose assemblies for aircraft and is now used to test all types of hose.

There is no accepted, standard impulse test. Some are more severe than others. Some systems use pressure direct from a pump, others use boosters. The SAE committee on aircraft tube and hose fittings is attempting to standardize impulse tests for aircraft hose.

Most aircraft hydraulic systems operate at 3000 psi. Many tests use this pressure as a base and apply surges by quickly actuating a control valve. Little is known about the effect of cycling frequency and rate of pressure rise on hose life. However, it is generally agreed that an impulse test will differentiate between good hose and bad.

When a small diameter, double-wire braided hose is impulsed at 300 psi and peaks of 4500 psi, it takes millions of cycles to cause failure. With a frequency of 35 cycles per minute (50,000 cycles per day) over a year may be required to cause failure. Unless the hose fails, there is no way to rate one hose better than another. Testing at 5000 psi shortens the time considerably.

A curve can be drawn after enough samples are run to indicate reliability of data. Performance at any pressure with any size hose can be predicted from the curve.

Impulse testing is the best known method of rating hose. Continued improvements in hose construction depend largely on evaluating and standardizing on test procedure. ▼▼▼

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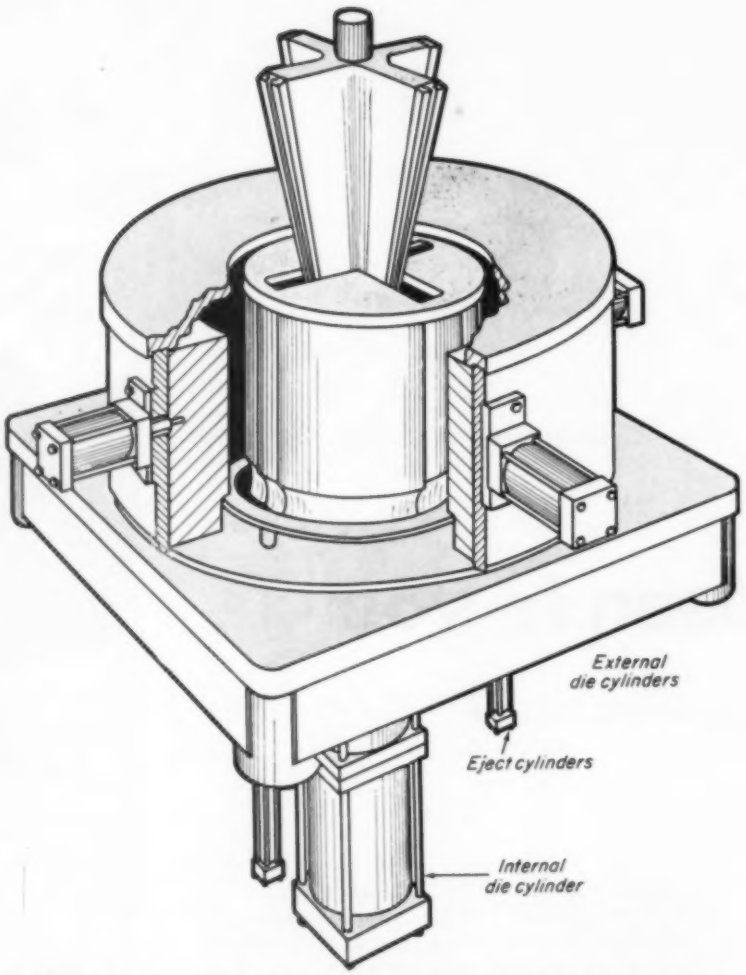


EXPANDER stretches steel tubing into irregular shapes. Drawing shows dies for a rectangular cabinet. Hydraulic cylinders close the external dies which form the outside dimensions. A tandem hydraulic cylinder pulls the internal die into place forming the inside of the cabinet.

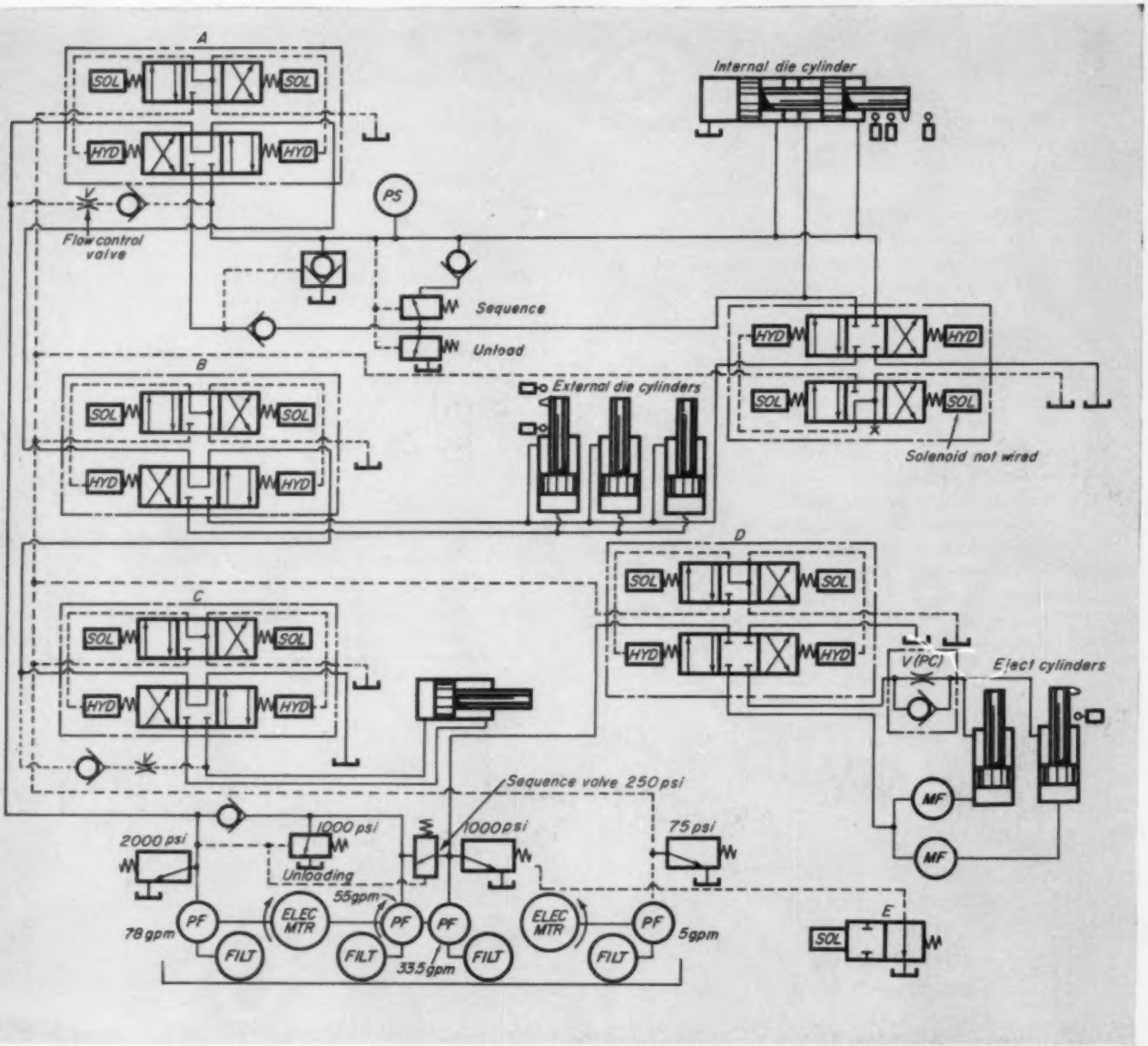
Expander's tandem cylinder gives high force in small space

• By **RALPH ROPER**
Wallace Expanding Machine Co., Inc.

and **JACK NEFF,**
Neff Engineering Co., Indianapolis, Ind.

EXPANDERS are being used to speed appliance assembly by forming welded tubing into irregular shapes for washer and dryer clothes baskets, splash tubs, and outer cabinets. These parts had been made by stamping and trimming segments which were then welded together. This process is slow and requires expensive assembly fixtures. The expander hydraulically stretches the tubing against an outer die. Square, round, and rectangular shapes are formed with accuracy.

• **Tandem cylinder action**—The internal die cylinder mounts on the back of the expander and forces the internal die segments out when it



HOW IT OPERATES

With the circuit idle, the 78-gpm and the 55-gpm pump unload through the tandem-center control valves. Pilot valve *E* vents the relief valve for the 33.5 gpm pump, allowing it to unload to tank. To start the cycle, a pushbutton actuates the solenoid on pilot valve *E* closing the vent line to the relief valve on the 33.5 gpm pump. It also shifts control valve *D* to retract the eject cylinders. A limit switch actuated by retracting the eject cylinders, shifts control valve *A* to retract the internal die cylinder. When the internal die cylinder is partially retracted, it actuates a limit switch centering its control valve *A*, and shifting control valve *B* to extend the external die cylinders.

When the external die cylinders fully extend they actuate a limit switch which centers valve *B* and shifts valve *A* causing the internal die cylinder to retract and complete its stroke. When the internal die cylinder fully retracts it actuates a limit switch centering valve *A*. Valve *A* remains centered until enough oil bleeds off through the flow control valve to decompress the circuit and close the pressure switch. This shifts valve *A* and extends the internal die cylinder.

When the internal die cylinder extends fully, it actuates a limit switch shifting control valve *B* and retracting the external die cylinders. When fully retracted they actuate a limit switch which centers valve *B* and shifts valve *D* to eject the part.

Oil displaced when the internal die cylinder extends, returns to tank through the pilot check valve which is held open by pressure on the cylinder. When the internal die cylinder retracts, a differential circuit forms, feeding back oil through the sequence valve. When the die meets the work and pressure builds up, the unloading valve, set at a higher pressure than the sequence valve, opens; thus breaking the differential circuit.

Valve *C* is used when an additional operation, such as dishing dryer fronts, is performed on the expander.

retracts. Its diameter must be small, so that it will not obstruct the dies when they are pulled in. To get the required force, with 2000 psi on the rod end, a 16-inch diameter piston would be needed. By using a tandem cylinder the diameter is reduced to 12 inches. Increased tonnage of the machine is obtained by mechanical advantage.

The tandem cylinder has two cylinders mounted inline. The piston rod extends through the end cap of the forward cylinder and connects to the piston in the rear cylinder.

Pressure fluid feeds into the rod ends of both cylinders to retract the pistons on the work stroke. The pistons extend fast when the fluid is directed to the forward cylinder's head end.

• **Power unit circuitry**—Four pumps deliver to the system. A 100-hp, double-shaft electric motor drives three of the pumps. The fourth is powered by a ¾-hp motor and supplies 75-psi oil to the pilot circuit.

One of the three main pumps delivers 78 gpm. Its delivery pressure pilots an unloading valve controlling delivery from the 55-gpm pump. It also pilots a sequence valve controlling delivery from the 33.5-gpm pump, either to the die cylinder circuit or the eject cylinders. When die cylinder pressure is between 250 psi and 1000 psi during periods of high demand, the unloading valve is closed. A total of 88.5 gpm from the other two pumps is directed to the system. If system pressure falls to 250 psi, the sequence valve closes, and output from the 33.5 gpm pump goes only to the eject cylinders.

• **Meter-in synchronizing**—The eject cylinders must move together when ejecting the finished part. If one cylinder moves faster, the part will jam between the dies. A flow divider synchronizes the cylinders. Oil is metered to each of the cylinders through fluid motors whose shafts are connected.

• **Differential circuit speeds production**—Pressure acts on the rod ends of both pistons to retract the internal die cylinder. Exhaust fluid flows through the sequence valve and joins fluid retracting the cylinder. This differential circuit continues until the die meets the work and pressure builds up to the unloading valve setting. ▼▼▼

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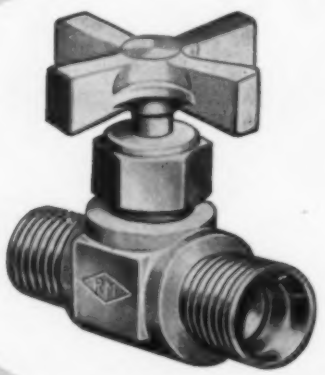

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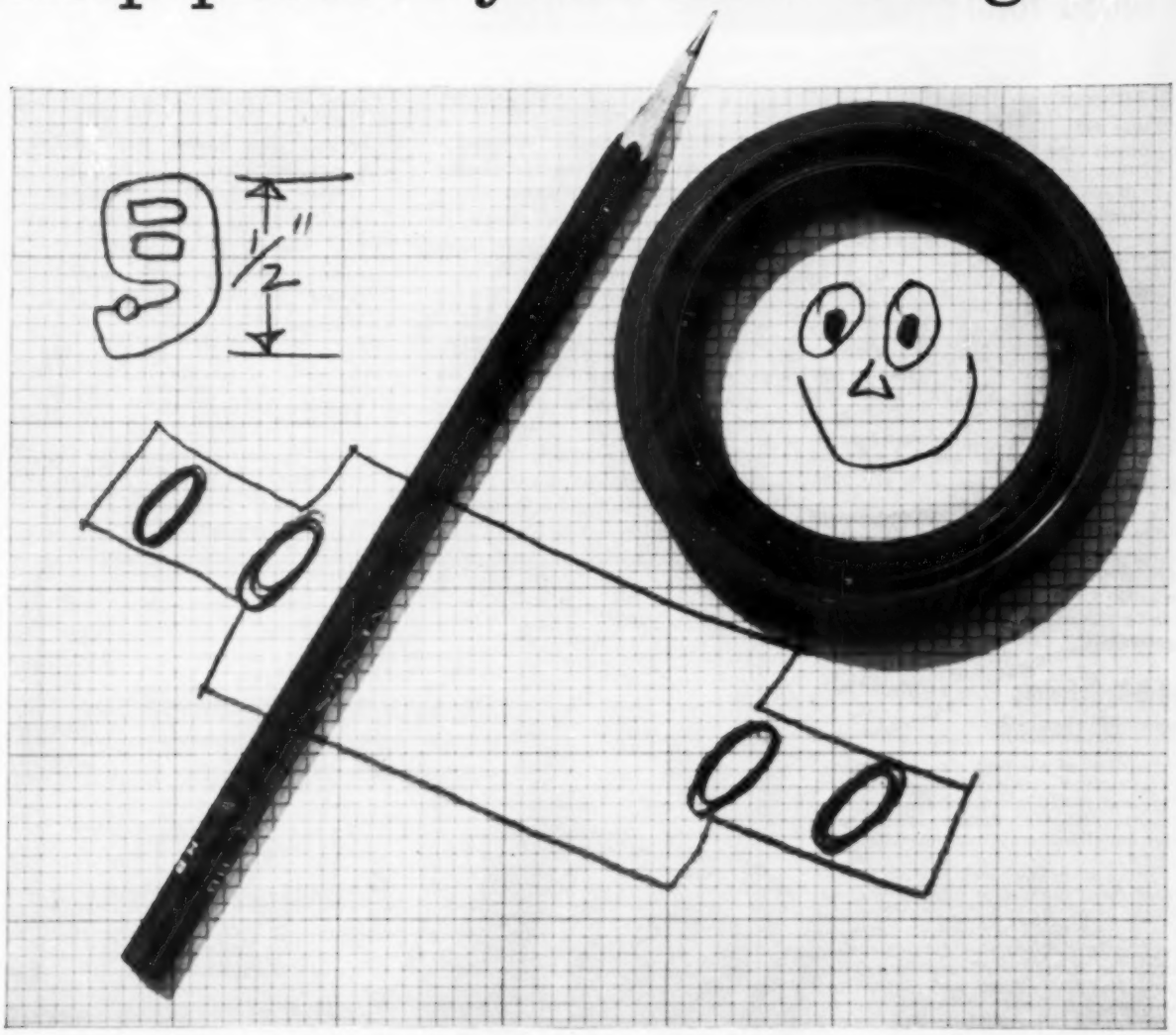

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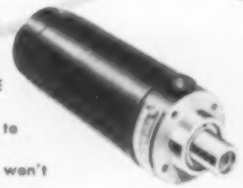
O-M Cylinders Hold Every Stroke to a Close Tolerance



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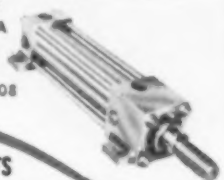

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Circle **122** on Time-Saver Card

Timed bumping for a

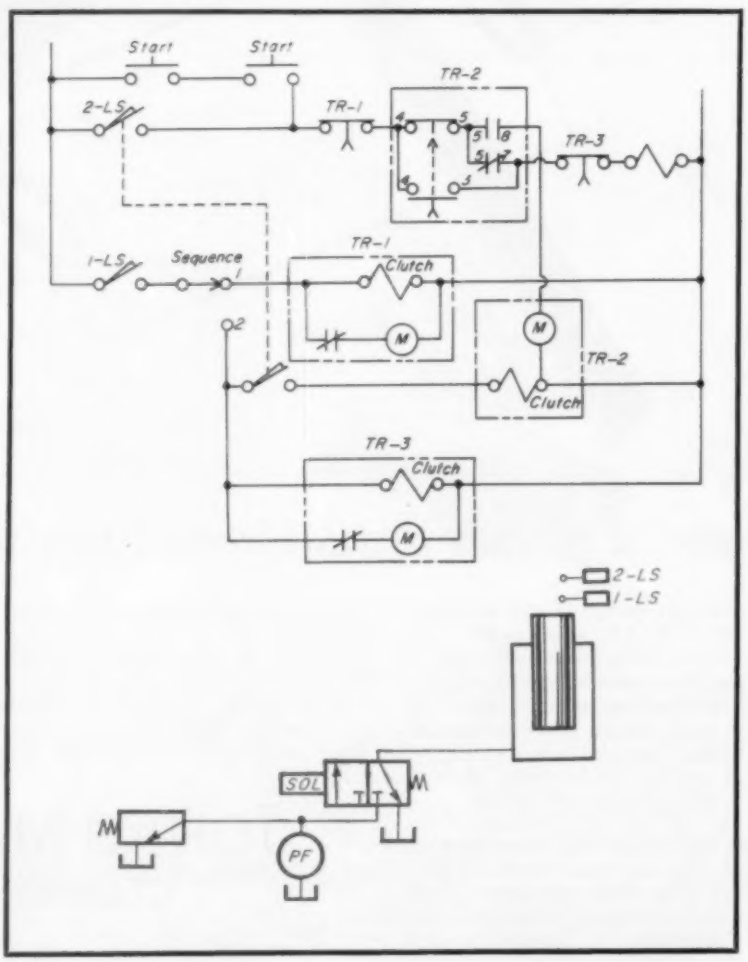
• By **MYRTEN G. SAAKE,** *Ribble Engineering Co., Hackensack, N.J.*

MOLDING plastics frequently requires opening and closing the press (*bumping*) several times to release gas as the plastic is formed. This circuit uses three synchronous motor timers to permit accurate adjustment of this sequence.

An operating cycle can be selected either with or without bumping, by positioning the *sequence* selector switch. In the No. 1 position of the switch, the press closes and remains closed for a timed period. In the No. 2 position the press closes, opens for a timed period, then closes, and finally opens completely.

With the selector switch in position No. 1, both *start* switches are held closed. This energizes the valve solenoid through normally closed contacts of timers TR-1, TR-2, and TR-3.

Limit switch 1-LS actuates when the press is nearly closed; 2-LS actuates when the press is fully closed. The operator can then release the *start* switches since they are by-passed by 2-LS. Limit switch 1-LS energizes TR-1 which opens its normally closed contacts



plastic press

at the end of the timed period. This de-energizes the solenoid and retracts the press.

When limit switch 2-LS closes, with the selector switch in position No. 2, the clutch of timer TR-2 is actuated. Its contacts 5-8 close and contacts 5-7 open. This de-energizes the solenoid, so the press starts to open, and also energizes the motor of timer TR-2. After the timed period, timer TR-2 contacts 4-5 open and 4-3 close to energize the solenoid again and close the press.

Timer TR-3, which has also been running, times out and its contacts open, de-energizing the solenoid valve and opening the press. ▼▼▼

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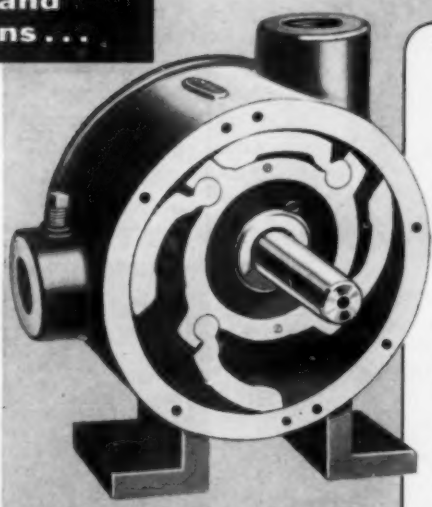

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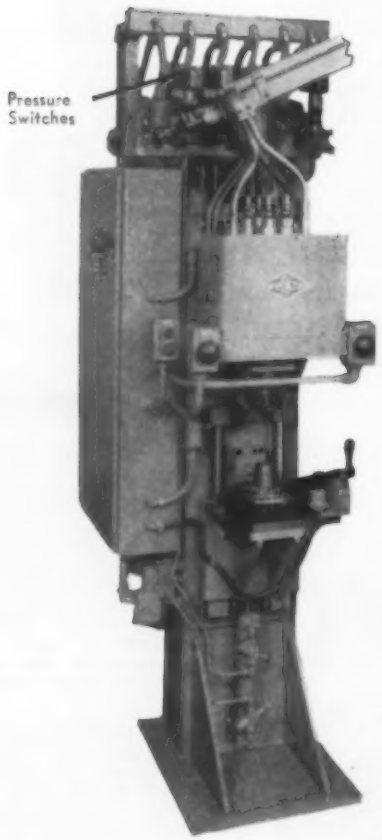
Circle **99** on Time-Saver Card

Electrical controls for torquing and pressing

● By **CLIFF F. GRAY,** *President, Gray Equipment Co., Dearborn, Mich.*



LIMITING SCREWDRIVER TORQUE

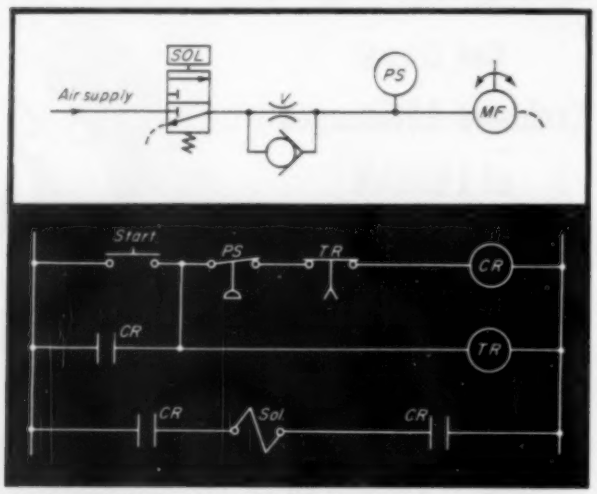
Air-motor driven screwdrivers on this automotive assembly machine develop as much torque as required to overcome the load. Air pressure on the motors builds up in relation to required torque. A simple way to limit torque accurately is to connect a pressure switch in the motor inlet line so that it actuates the solenoid valve at the maximum torque value. When pressure reaches the switch setting, its contacts open and de-energize the 3-way solenoid valve controlling air flow to the screwdriver's motor. The motor then exhausts through the valve.

A fast acting, piston type pressure switch was selected for this application. An external screw adjustment permits setting it from 25 to 200 psi. A honed piston bore and direct switch aciton give it a repeat accuracy of 2%. ▼▼▼

PRESSING A SEAL

In pressing in oil seals with a hydraulic cylinder, manufacturing tolerances sometimes result in seals which are too tight to seat properly and others which press in too easily to seal properly. Sensing cylinder position with a limit switch is the obvious method of telling that the seal is pressed home.

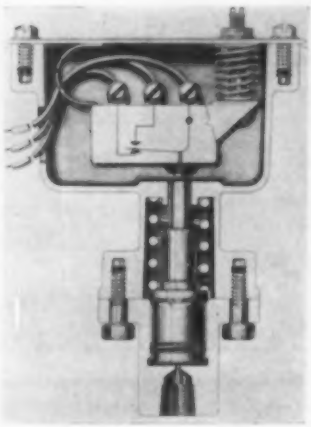
A pressure switch is used to indicate sufficient force for a tight assembly. However, once the seal is pressed home to



AIR AND ELECTRICAL DIAGRAMS for one of the five screwdrivers. Air to each screwdriver motor is metered through a flow control valve.

When the motor is running freely, there is a high air flow through the flow control valve. Most of the pressure drop from line pressure is across the orifice in this valve. When the screwdriver goes to work and torque builds up, the motor slows down reducing air flow. Pressure then rises at the pressure switch.

A timer is actuated when the cycle is started. It de-energizes the solenoid valve if there is no screw in the hole. Then the screwdriver could not build up pressure.



PISTON TYPE PRESSURE SWITCH has single-pole, double-throw contacts (only single-throw used in this application). Its fast action makes this design work well.

Courtesy Barksdale Valves

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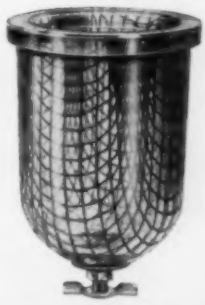

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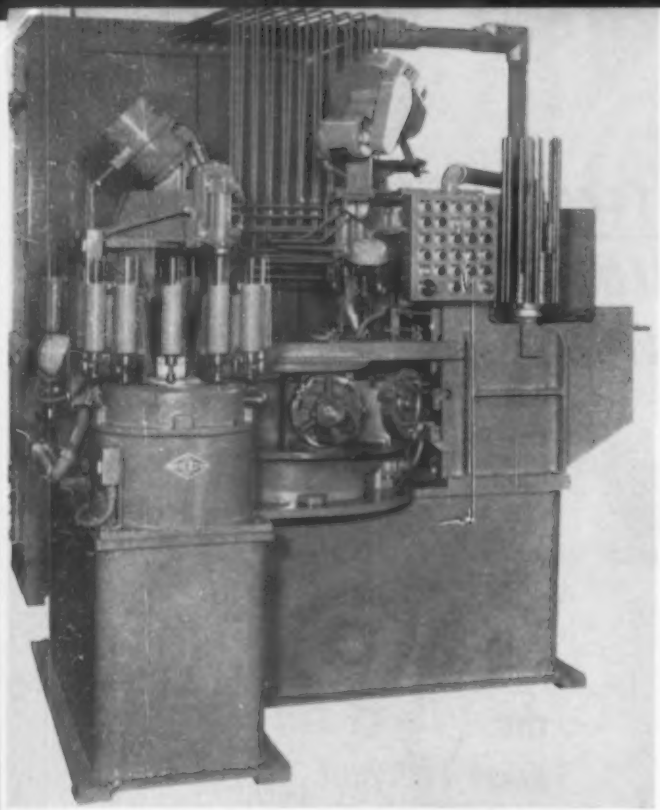
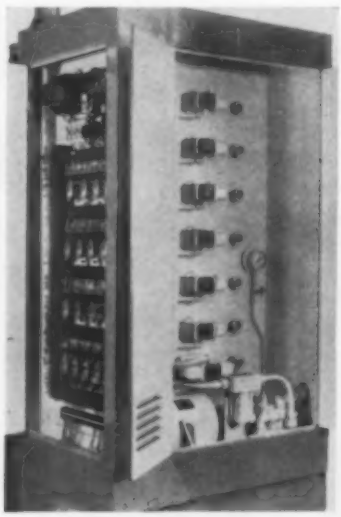


AUTOMATIC ASSEMBLY MACHINE sub-assembles two check valves and final assembles a complete pump body. The check valves are assembled on two dial index tables. They are then assembled into the pump housing. Oil seals, fed from an indexing magazine are passed into the housing.



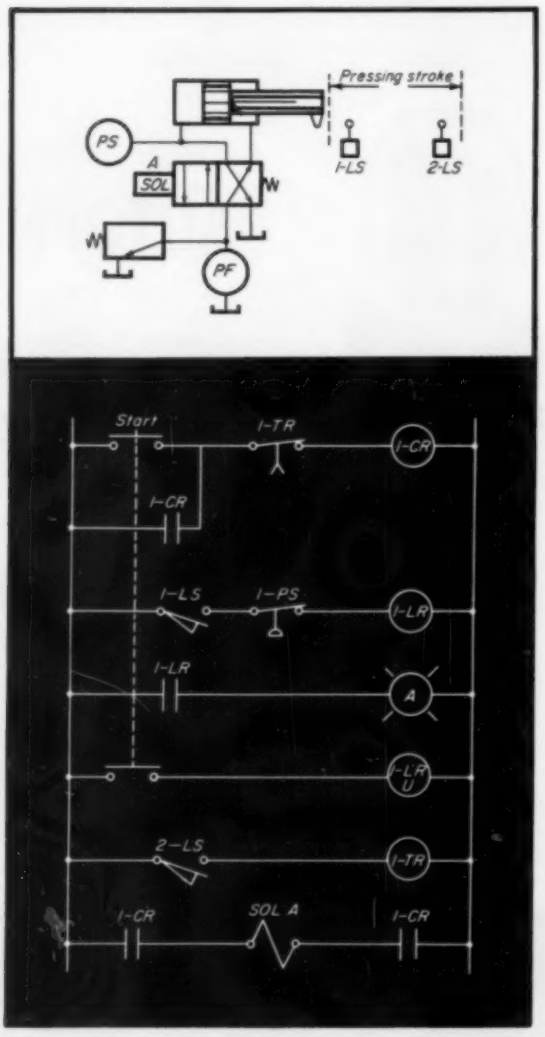
PUMP, FILTER, AND VALVES are mounted in a metal cabinet. This keeps the components clean, reduces piping, and simplifies maintenance. Electrical controls for the machine mount in a separate section of the same cabinet.

the bottom of the pocket, cylinder pressure rises to line pressure, regardless of how easily the seal presses in. Therefore, a limit switch is combined with the pressure switch so it senses pressure during the time the seal is being pressed in and before it is home.

If a seal is in place, pressure switch 1-PS (electrical diagram) opens as the cylinder starts pushing the seal into place. This prevents actuating latching relay 1-LR when limit switch 1-LS is actuated. If there is no seal in place, or if the seal is too loose, the pressure switch is not actuated. Then the relay actuates (and latches in) lighting the indicator lamp until a new cycle starts. The start switch actuates the relay's trip coil to reset it.

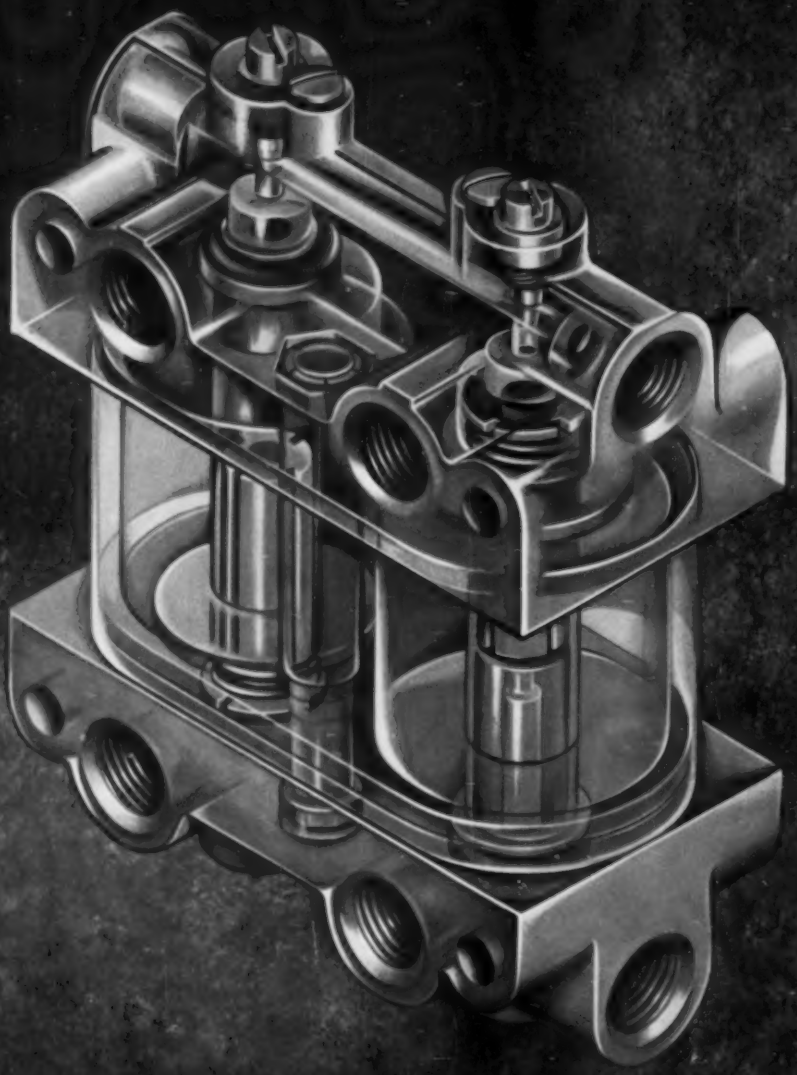
Limit switch 2-LS is actuated just before the end of the pressing stroke to start time delay relay 1-TR. This insures a dwell at the end of the pressing stroke for proper seating. When it times out, it deactuates relay 1-CR and the valve solenoid, returning the cylinder.

The timer must be actuated *before* the end of the pressing stroke because the seals vary in size. ▼▼▼



ELECTRICAL AND HYDRAULIC CONTROLS for pressing a seal protect against a loose seal or no seal at all.

Circle 146 ➔



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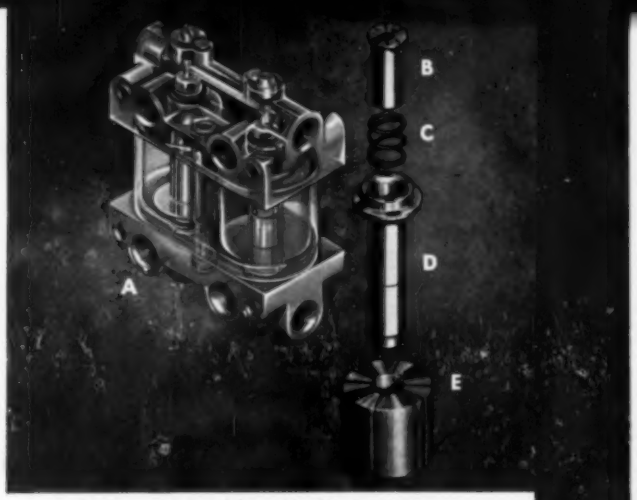
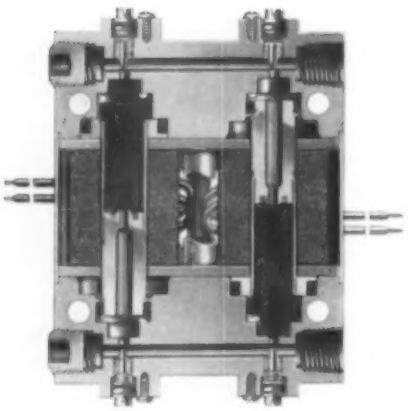


A. Transparent view of 4-way solenoid valve B. Plunger C. Plunger return spring D. Sleeve E. Coil

SKINNER four-way solenoid valves available in three basic types



The Skinner V9 solenoid valve is two 3-way valves in one compact housing. Both valves may be independently controlled and metered to provide accurate, dependable control of single- or double-acting cylinders, or larger pilot-operated valves.

V9 types are available without adjustable flow and with metering at both exhaust ports, both inlet ports or full metering of all ports.

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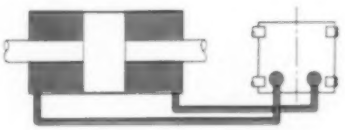
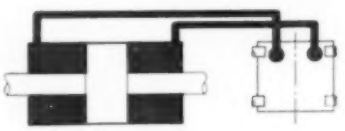
C_v Factor—$\frac{1}{64}$" .052, $\frac{1}{16}$" .095, $\frac{3}{32}$" .156, $\frac{1}{8}$" .214
Mounting—$\frac{1}{4}$" through-bolt holes.

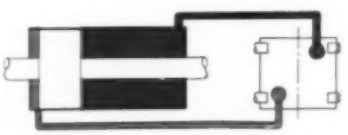
Normally closed—normally closed V933 valves with a neutral position. Generally applied on double-acting cylinders where the piston is in a neutral position without pressure when both coils are de-energized. This permits manual shifting of the piston without operating the valve.



Normally open—normally open V955 valves with a neutral position. Generally applied on double-acting cylinders where both sides of the piston are to be open to pressure when both coils are de-energized. Under certain conditions, the first operating stroke of double-acting cylinders will be smoother with this valve in use.



Normally closed—normally open V935 valves with no neutral position. Generally applied on double-acting cylinders where the piston is to be in retracted or extended position with pressure when both coils are de-energized. Wiring is simple—both coils are operated simultaneously and can be controlled by one single-pole, single-throw switch.



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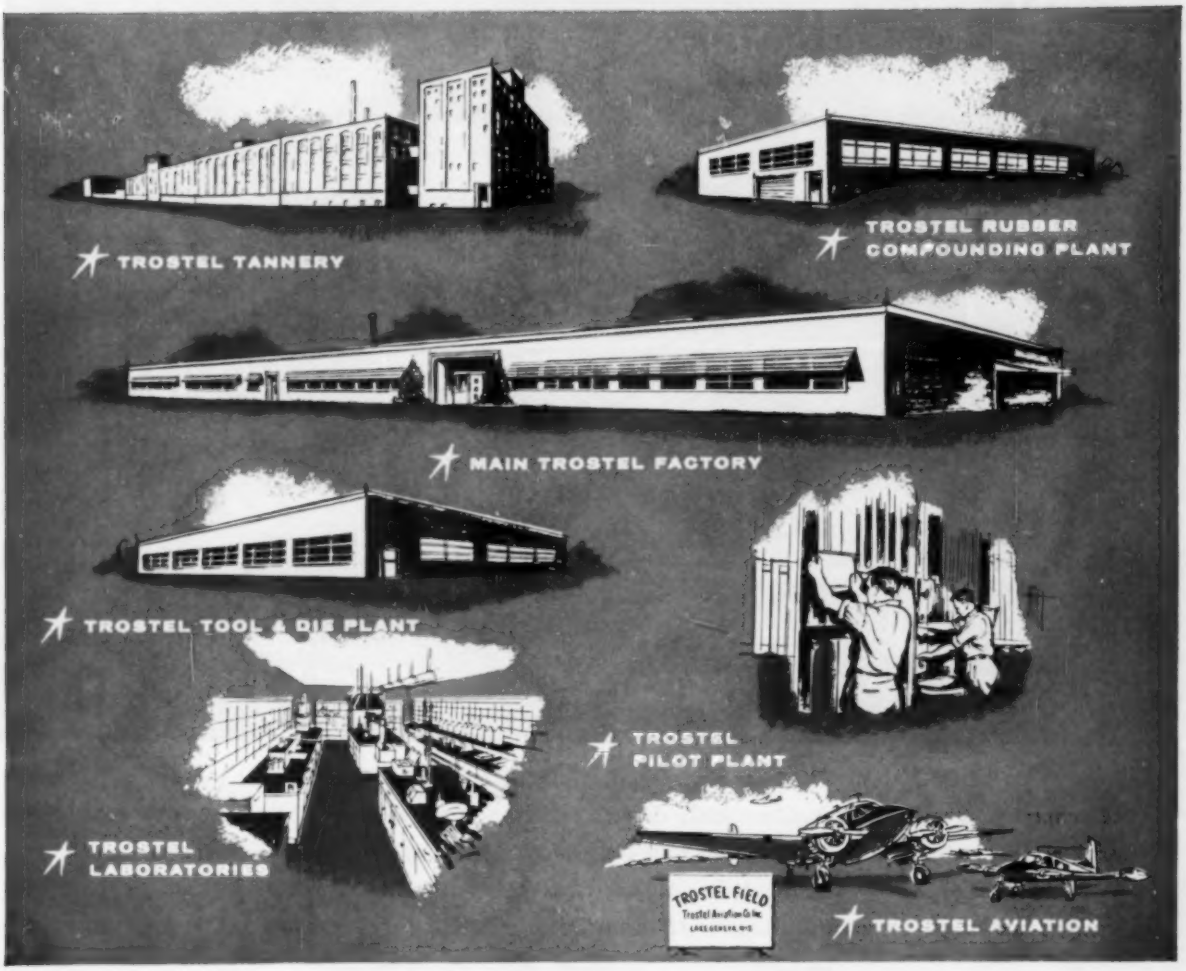

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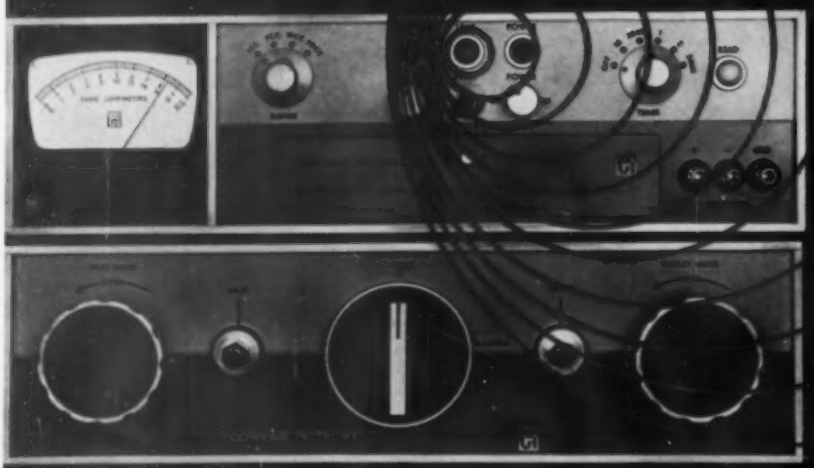

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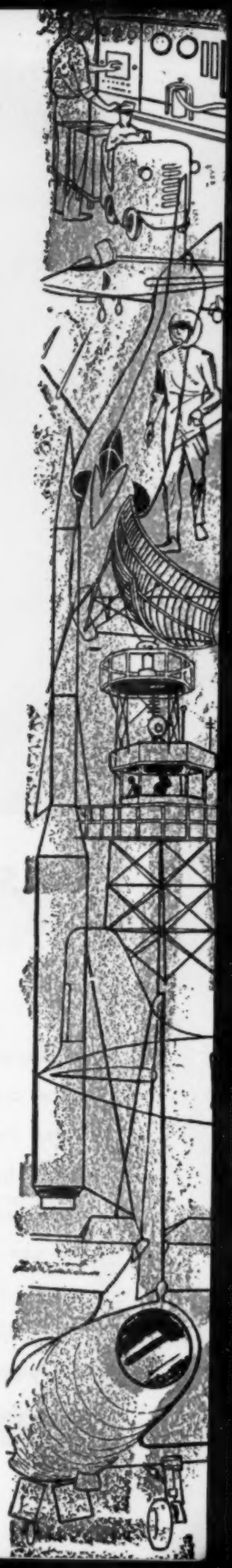


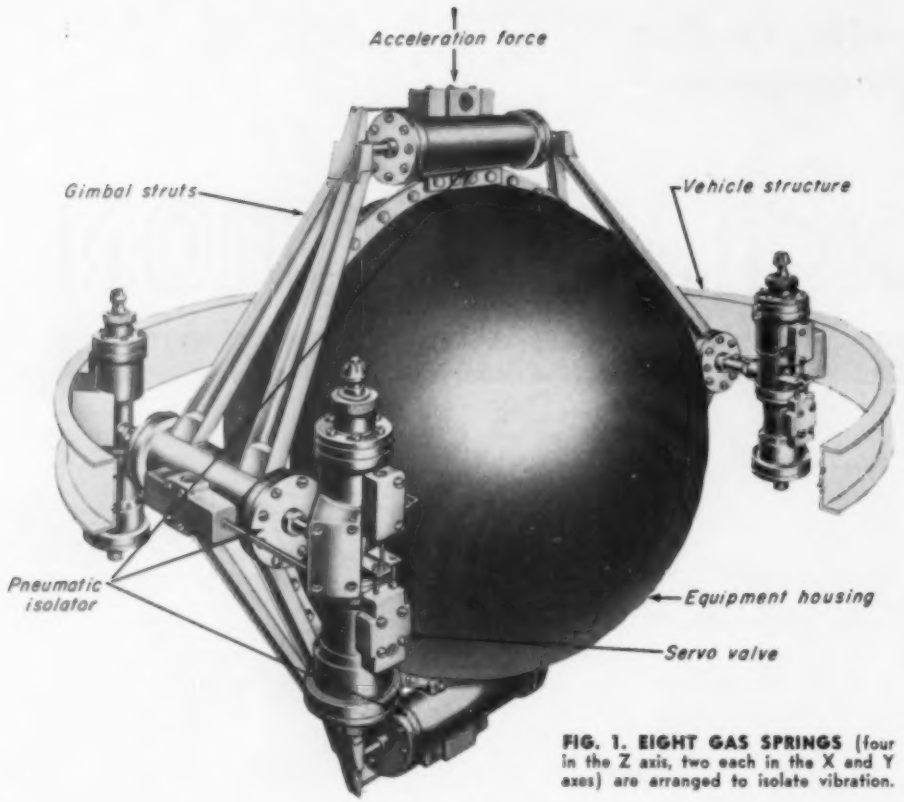


FIG. 1. EIGHT GAS SPRINGS (four in the Z axis, two each in the X and Y axes) are arranged to isolate vibration.

Gas springs isolate vibration

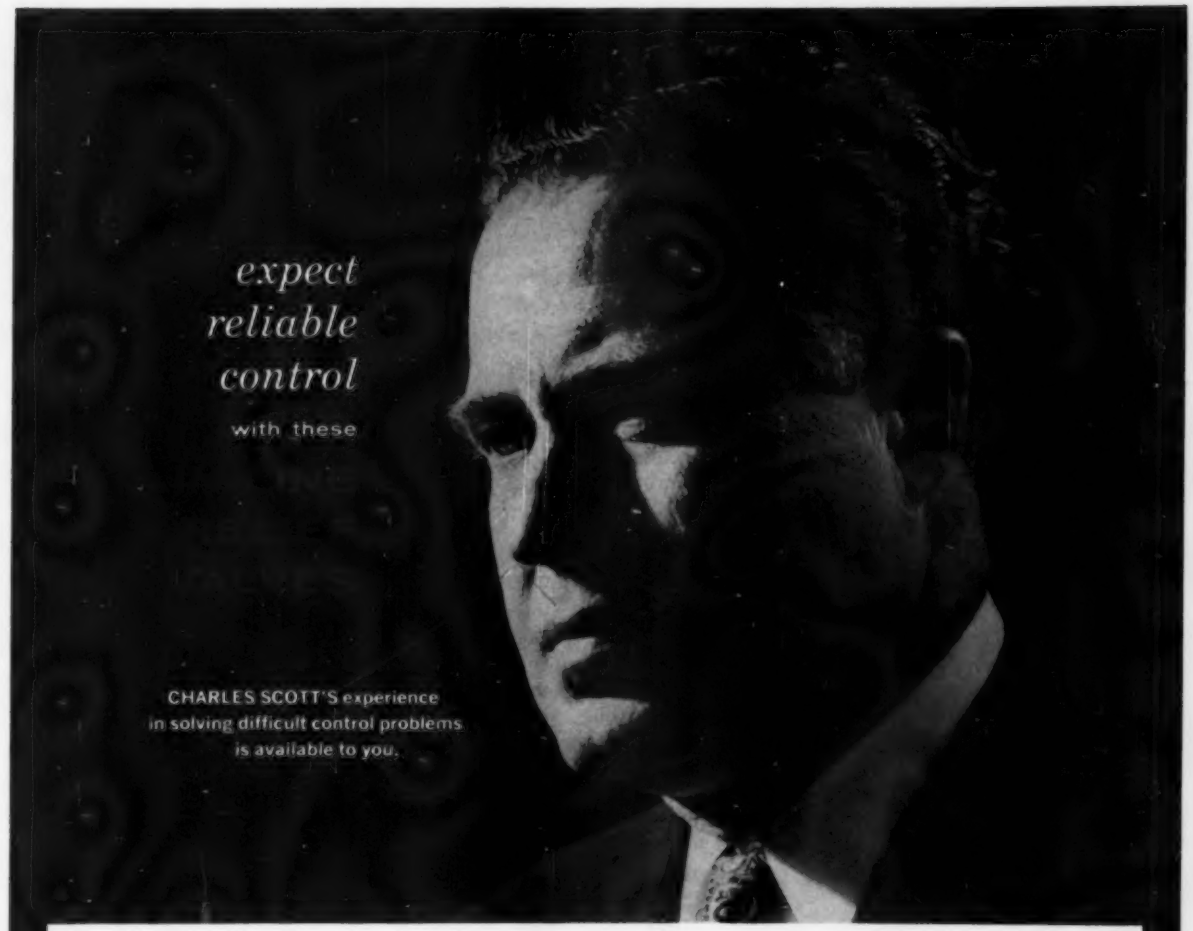
• By **A. E. SCHMIDLIN** and **H. A. POOLE, JR.**, *Walter Kidde & Co., Belleville, N. J.*

Guidance equipment on space craft must be protected from excessive vibration. A gas spring absorbs a large range of frequencies and can be made to compensate for wide variations in g loadings. Restraining load at any position can be varied by modulating gas pressure.

ROCKET propulsion systems impose very high accelerations and vibration. As these increase, components in the vehicle undergo a multiplication of gravity, or g loading. The burning fuel itself adds vibratory harmonics which extend the total vibration frequency range over a large band. Both the vibration and the displacement due to acceleration loads disturb the accuracy of the delicate guidance systems of the rocket.

To isolate this sensitive equipment from these effects, the standard method has been to use rubber or metallic shock mounts. Characteristics are such that the combination of mass supported and the mount's effective spring rate gives a minimum stable natural frequency of about 10 cps. In space vehicles, the frequency range can extend below 10 cps. To design a conventional shock mount for a natural frequency of about 3 cps, the effective spring rate becomes so small that the static deflection due to the weight of the mass becomes excessive.

• **How they compare**—A pneumatic spring can vary the restraining load at any position by modulating gas pressure. As a vibration isolator, it can have a low natural frequency and yet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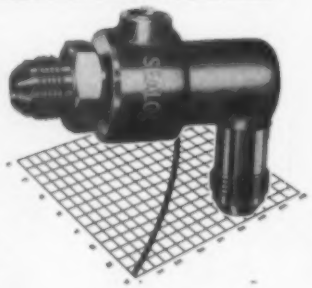

6 G.P.M. at 3,000 P.S.I. aircraft-type swivel illustrated in ½" O.D. tube size. Extremely low swiveling torque (10 inch-pounds at 3,000 P.S.I.) means minimum power loss. Meets or exceeds MIL J-5513A.

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compensate for changes in g loadings of 900% or more without large positioning error.

Figure 1 shows basic parts of a vibration isolation installation. Four isolators are used in the longitudinal axis because of heavier accelerations in that axis. The X and Z axes have less severe maneuvering loads. This requires an isolator that is pressurized in two opposing gas spring volumes, but which has a relatively low gain control on one side of the piston. The configuration chosen is effective in providing rotational stiffness necessary for accuracy of the guidance package.

There are limits to the use of a gas spring as a substitute for a linear mechanical spring. These limits do not mean bulkiness or lack of versatility. On the contrary, even for simple designs of high spring rate, a trapped volume gas spring can be made competitive with mechanical springs of the same precision.

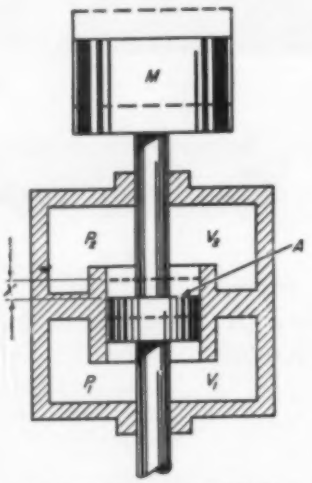


FIG. 2. GAS SPRING DIAGRAM

• **Analyzing performance**—If we assume that action of a gas spring is an isothermal process, initial pressures P_1 and P_2 and volumes V_1, V_2 are related to final pressures P_{10} and P_{20} and volumes V_{10}, V_{20} as follows:

$$P_1V_1 = P_{10}V_{10}$$
$$P_2V_2 = P_{20}V_{20}$$

Introducing piston area A, and its stroke x,

$$P_1(V_{10} + Ax) = P_{10}V_{10}$$
$$\text{and } P_2(V_{20} + Ax) = P_{20}V_{20}$$

for an upward displacement of mass M.

$$F_1 = P_{10}A\left(1 - \frac{Ax}{V_{10}+Ax}\right)$$

$$F_2 = P_{20}A\left(1 + \frac{Ax}{V_{20}-Ax}\right)$$

The effective spring constant of the air cylinder is then:

$$K = \frac{-d}{dx}(F_1 - F_2)$$

The combined spring constant K_o is the difference between the effective spring rate of each volume. Since x is maintained at a small value, the spring rate becomes simply:

$$K_o = \frac{P_{10}A^2}{V_{10}} + \frac{P_{20}A^2}{V_{20}} \quad \ldots(1)$$

But since pressure P_{10} must support the mass under acceleration as well as resist pressure in the upper cylinder,

$$P_{10} = P_{20} + \frac{n\,Mg}{A} \quad \ldots(2)$$

where n=number of g's on mass M
Thus the system spring constant can be written as

$$K_o = \frac{P_{20}}{V_{20}} + \frac{P_{20}A^2}{V_{10}} + \frac{nMgA}{V_{10}}$$

Equation 1 shows that variables in a pneumatic spring can be manipulated to achieve constant transmissibility for varying load conditions. This is the ultimate in vibration isolation.

In our application it means varying the pressures P_{10} and P_{20} in accordance with Equations 1 and 2 for a fixed mass, constant piston area, and constant volume pneumatic spring. Size of the isolator, convenient pressure level, dynamic seal friction, and nonlinearity as a result of large piston travel are optimized by considering parameters in these two equations. Also important is the effect of large excurions at natural frequency, where transmissibility may be as high as 3. The more the system is allowed to peak at its resonant frequency, the faster the attenuation above this frequency.

This fast attenuation is desirable in an isolator as in a filter. The spring-isolated damper, Figure 4, cuts this peak and still maintains good filtering.

For simplicity, the isolation problem can be approached as two separate design conditions:

(1) a servo control of very low band pass that would be out of the amplitude response picture at 3 cps

(2) a mass-spring-damper system with properly regulated gas spring pressures at all g loads. This can be done if the above requirements are not incompatible.

• **Servo valve requirements**— Although pneumatic servo control protects the system against shock and rapid deceleration, its major job is to isolate vibration during pre-launch handling, launching and the guided portion of its flight. The more critical requirements of servo valve design which are derived from this acceleration profile are:

a) Supply enough air to support the mass at 10 g's.

b) Supply air fast enough to match changing loading at peak g, without allowing the mass to hit stops.

c) Control relative position of the mass so that total travel is limited to less than 1½ inches.

d) Stability between 0 and 2000 cps, with no high frequency or high amplitude hunting resulting from load changes.

e) No excessive leakage.

Inlet pressure and flow rate needed for peak requirements, plus the exhaust flow at low g loading may produce a servo-valve with non-uniform inlet exhaust characteristics. The valve design must then be compromised to meet average load conditions. To get the best stability, positioning response, and transmissibility in the same unit, modifications must be based on an analysis of the overall system. As these three characteristics are difficult to achieve in the same design, emphasis is on transmissibility and stability for best results. ▼▼▼

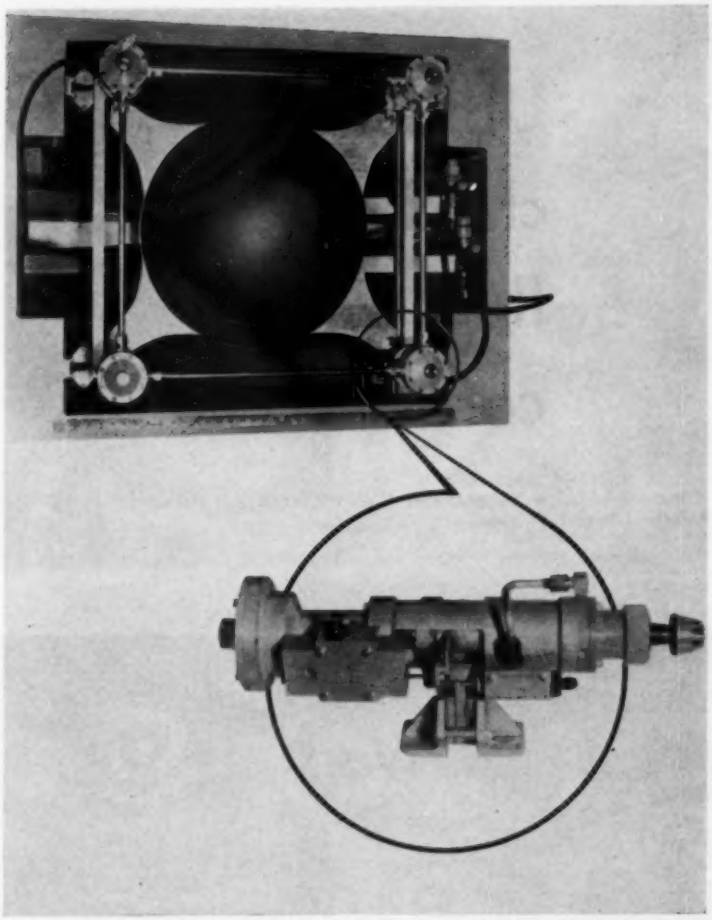


FIG. 3. ROCKET TEST SLED INSTALLATION for checking vibration isolation in the missile's longitudinal axis, where g loading and vibration is most critical.

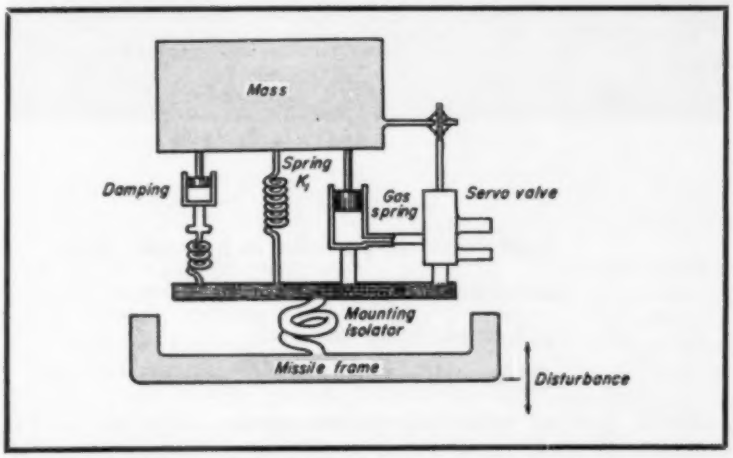
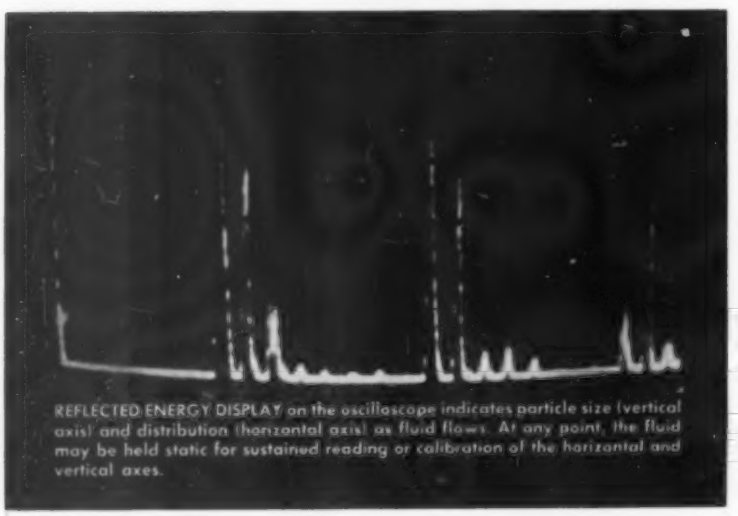


FIG. 4. PNEUMATIC VIBRATION ISOLATOR with spring-isolated damper.

Ultrasonics checks fluid contamination

• By WARREN STRITTMATTER and CHARLES ALBERTSON
Gruman Aircraft Engineering Corp., Bethpage, L. I., N. Y.



REFLECTED ENERGY DISPLAY on the oscilloscope indicates particle size (vertical axis) and distribution (horizontal axis) as fluid flows. At any point, the fluid may be held static for sustained reading or calibration of the horizontal and vertical axes.

Contamination particles in hydraulic fluids can be rapidly counted and sized, using ultrasonic vibration. Fast, continuous analysis of operating systems gives an accurate picture of fluid quality

SUCCESS of an aircraft or missile flight may depend on proper functioning of hydraulic components. Operation of valves and other components, in turn, depends on fluid cleanliness. To check filtration, you must be able to determine particle size and distribution. Testing fluid samples by filtering and weighing is not only time consuming, but inaccurate. Laboratory contamination tests using ultrasonic equipment give a fast, continuous method of sizing and counting particles in large fluid volumes.

• **Present test methods**—Filter efficiency is presently tested by several methods. In one, test dust is added to standard fluid previously filtered to 2 microns. The fluid is circulated through the test filter for 5 minutes for each dust charge. A sample is then drawn off. This procedure is repeated until pressure drop across the test filter is 40 psi. The samples are centrifuged, and the contaminant is examined under a microscope to see what percentage of test particles were removed.

For a filter to meet specification MIL-F-5504-A it must remove more than 98% of all particles whose two smallest dimensions are greater than the rating of the filter element.

Another method uses tiny glass beads added to clean oil, circulated through the test filter and sampled. A weighed Millipore filter collects the beads, then is dried and weighed again. The weight difference is assumed to be the weight of the beads.

The patch test used by many aircraft manufacturers to evaluate aircraft hydraulic system cleanliness, is merely a patch-color comparison. Contaminant size, type, and percentage are ignored.

• **Ultrasonic testing**—In cooperation with Sperry Products, Grumman Aircraft developed a system with a potential of detecting and measuring particles to one micron (.00003937 inches) under either static or dynamic flow conditions. Standard ultrasonic equipment was modified to suit our purposes. A reflectoscope is the main

TEST SET-UP shows reflectoscope at left.

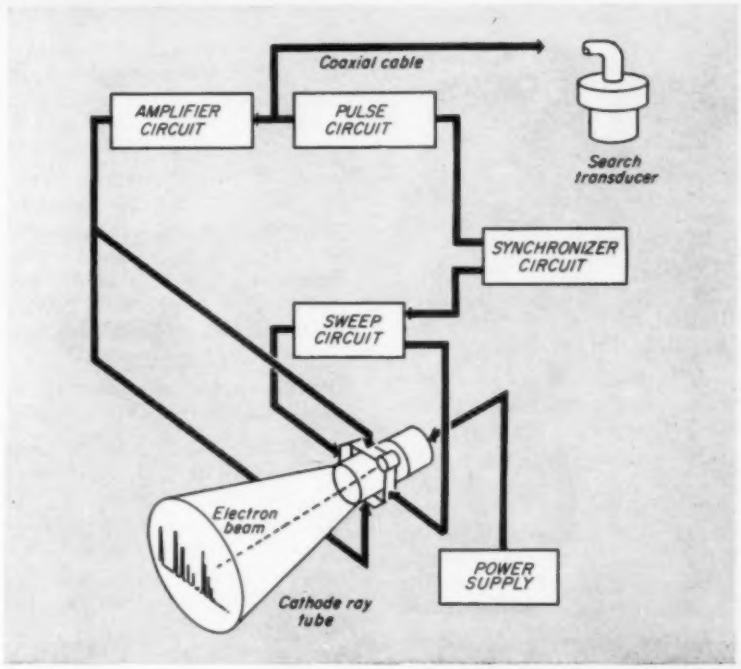
ULTRASONIC METHOD for continuous flow testing gives exact and instantaneous reading of contaminant size and distribution. It eliminates errors of sampling methods.

measuring component of the system. It consists of an electronic circuit to generate pulses; a transducer to convert the pulses into ultrasonic sound, and reconvert reflected ultrasonic sound back to electrical impulses; and electronic circuitry to amplify and display the reflected pulses on a cathode ray screen. The basic principle is that an ultrasonic wave front travels through a homogenous medium without reflection until it meets a discontinuity or change of density.

In practice, the transducer is acoustically coupled to the test fluid. When a short burst of ultrasonic sound is sent through the fluid, reflected energy varies as the fluid density, which depends on contamination. The transducer converts reflected energy into electrical signals which are amplified and displayed on the vertical axis of an oscilloscope. Repeating this sequence presents a continuous display.

The horizontal axis of the oscilloscope is connected to a sweep circuit, so that swept distance is proportional to length of the fluid column being scanned. Particle distribution is read on the horizontal axis. Distance on the vertical axis represents particle area.

The vertical axis is calibrated by introducing particles of known size. The reflected energy displays are counted and measured, then compared with samples which are optically counted and measured to check accuracy. Correlation has been shown to be excellent.



Some tests require an alarm set to warn of objectionable particle size or distribution or actuate a bypass selector valve system. Other tests may require as many as six counters to grade particle size ranges.

To prevent counting a particle more than once, a flow meter controls the repetitive rate of the reflectoscope. This makes sampling rate proportional to flow rate, so that a particle is in the test area only long enough to be sampled.

Entrained air bubbles also reflect the pulsed energy. However, air bubbles are easily differentiated during a static test because of the difference in gravimetral weights. The display of the air bubble reflected will move in an opposite direction from the heavier particles along the display's horizontal axis. ▼▼▼

AVIATION NEWS

from the fluid power field

L. J. Wing Mfg. names manufacturing manager

Adolph R. Schaub is now manufacturing manager of the L. J. Wing Mfg. Co., Div. Aero Supply Mfg. Co., Inc., Linden, N. J. He was with M. W. Kellog Co., in project engineering, purchasing, and production management.

Schaub

Hueffed

United Aircraft appoints three

Robert G. Hueffed has been promoted to general sales manager, United Aircraft Products, Inc., Dayton, Ohio. He succeeds Frank A. Ryan, former sales manager, now vice-president of sales, who made the announcement. Hueffed is a member of the American Management Association and the American Helicopter Society. William A. Glaser will manage the firm's East Coast contractural engineering office, New York City. Glaser was graduated from Case Institute of Technology and majored in Electrical Engineering. He Studied law at Loyola University, New Orleans.

Gottlieb joins E. B. Wiggins oil tool

Seymour Gottlieb has joined the E. B. Wiggins Oil Tool Co., Los Angeles, Calif., as engineering manager. He was recently with Aerojet General Corp. as director of long range planning for their Structural Plastics Division.

Carrier Enterprise gets most powerful catapult

The Navy has accepted from Carrier Corp., Syracuse, N. Y., a catapult system for heavy jet bombers. It is nearly twice as powerful as those in service. Driving force is furnished by compressed air, jet fuel, and water. The system can accelerate an aircraft from zero to 200 mph in less than three seconds, over 248 feet. It operates at 30-second intervals. The system was developed and tested during the past year at the Naval Air Test Facility, Lakehurst, N. J. Four of the catapults will be installed on the nuclear aircraft carrier Enterprise.

Bendix-Hamilton names East Coast representative

Bertram L. Boone has been made East Coast sales application engineer for the Hamilton division of Bendix Aviation Corp. Boone joined the company in 1957 and was in engineering and manufacturing before he joined the sales organization.

Kidde opens Aero-Space Div.

Walter Kidde & Co., Inc., has created the Kidde Aero-Space Division. It will handle the products, services, and engineering of Kidde's Aviation Division and its R&D Division.

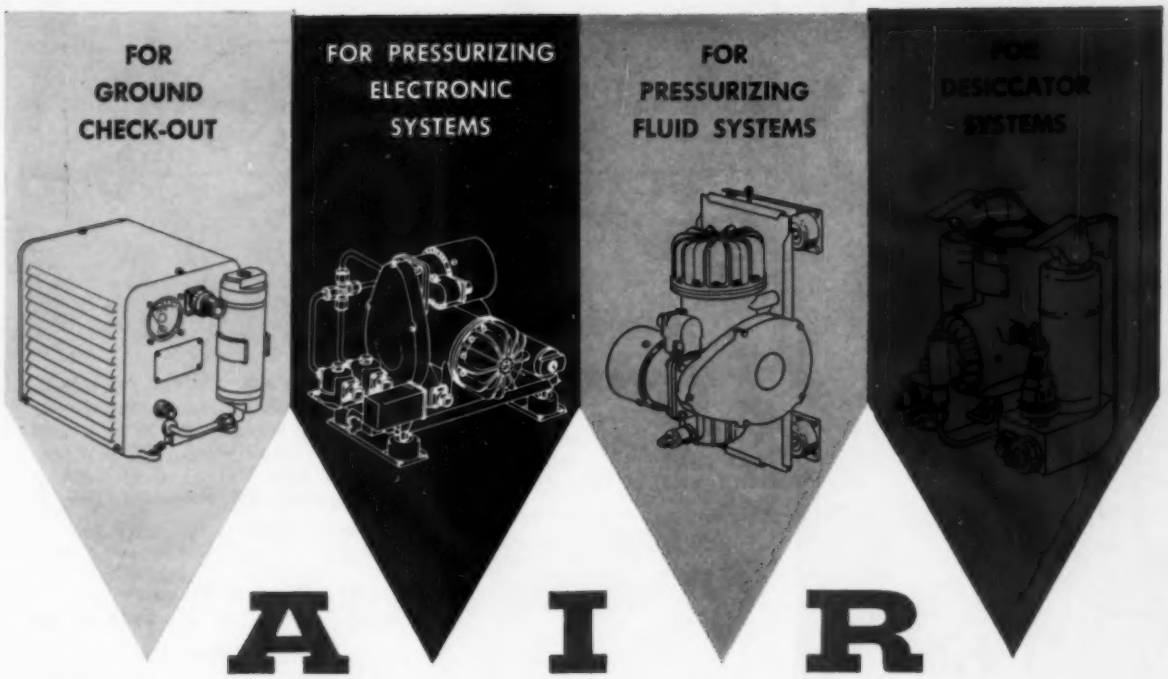
Lockheed orders special filters

Lockheed Aircraft has ordered 500 units of a new, pressure-locked filter element made by Purolator Products, Inc., Rahway, N. J. The specially-designed filter has no built-in contamination. Element, end caps, and center tube are locked together under extreme pressure. The units replace those used in Lockheed Electras and F-104G jets.

Boeing tests in pneumatic lab

The pneumatic test building of the laboratory is being used to test an air-conditioning water separator for Air Force B-52G missile platform bomber at the Boeing Airplane Co., Wichita, Kansas, Division. The pneumatic laboratory has an 800-hp compressor with air source capability of 2,800 cfm at 300 psi. Plant air is supplied at 100 psi at the rate of 7600 cfm.

Test facilities include systems mockup areas with hydraulic power, compressed air, electrical, and mechanical installations. Equipment projects completed or underway include development of multipoint hydraulic flight control actuators within flight control contours, development of high temperature hydraulic seals, application of electromechanical servo valves to spectral power density, and use of helium as a heat transport fluid.



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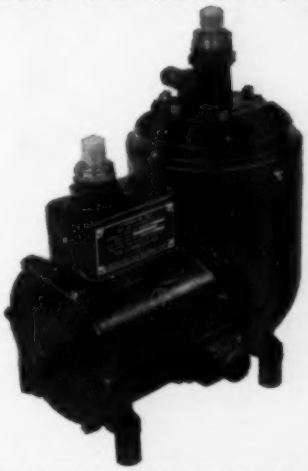

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psi. Repeatable accuracy to ±0.5% of original setting. Rated for 6 amp at 125/250 vac, SPDT. Capsular sensing element gives sensitivity, repeatability, and low hysteresis and drift over temperatures from —65 F to 300 F. Only one moving part, eliminates use of springs, linkages, and bearings. Set adjustable actuating setting without removing while system is in normal operation. Meets MIL-E-5272A. Will take 100 g's shock.—*Pamar Electronics Co., Farmingdale, N. Y.*

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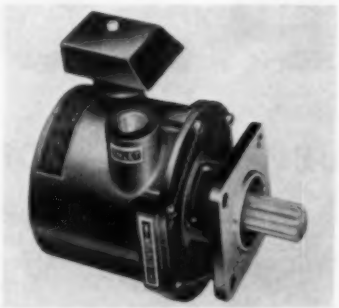

fittings are eliminated. Installation is on engine accessory pad in any position. Organic coupling with integral, 12-tooth spline absorbs all torsional vibration at engine accessory drive. Minimum capacity at 4½" Hg and 1500 rpm is 4 scfm. 4½" Hg obtained at 1000 rpm minimum speed. 4000 rpm is maximum continuous speed; 5000 rpm, intermittent. Weighs 3.6 lb with overhang moment of 9.6 in-lb. 5⅛" x 3⅜" x 5" overall size. 250 F maximum exhaust temperature. Model 113. *Airborne Mechanisms Div., Randolph Manufacturing Co., East Cleveland, Ohio.*

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Bellows Rotary Shaft Seal . . . is all metal

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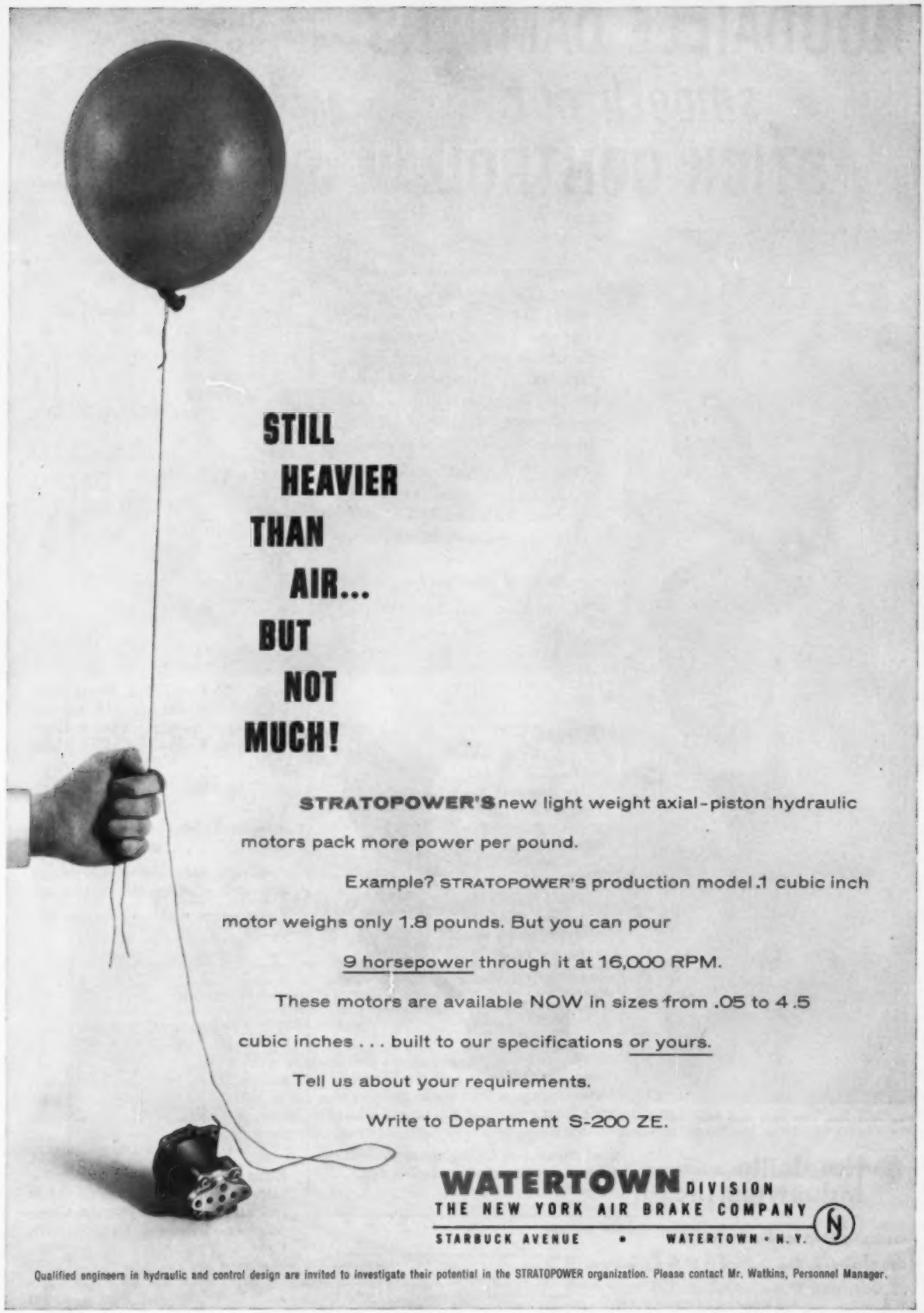
Continued on page 146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Three types of Houdaille hydraulic dampers are shown here. At the right: Rotory Viscous Damper for the Northrop N-156. Below: Rotary Vane Type Damper for the Northrop T-38; and a new Rotary Type Damper.

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AIRCRAFT COMPONENT DATA

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Relief Valve . . . has high flow rate

Flows to 45 gpm at pressures to 3000 psi. Operates at temperatures

from —65 F to 275 F. Meets MIL-L-15017 for aircraft and submarines. Zero leakage.—*Vinson Engineering & Sales Corp., Van Nuys, Calif.*

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Missile Tubing Joints . . . design catalog

40-page catalog contains design data and product information on

joints for a wide range of temperatures and pressures. It covers liquid and air systems.—*Aeroquip Corp., Marman Division, Los Angeles, Calif.*

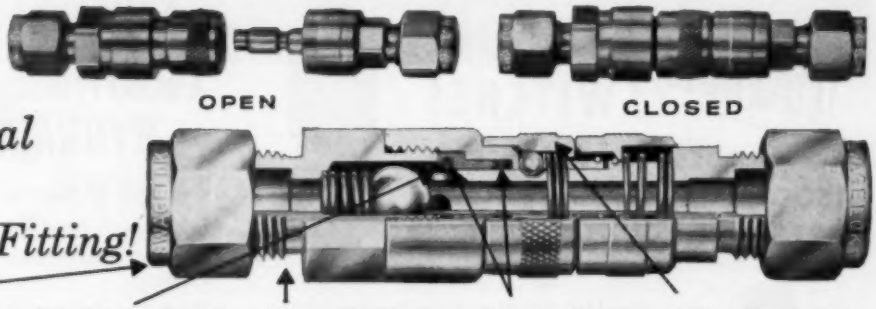
Circle **505** on Time-Saver Card

Continued on page 148

What's the secret of this fast, positive-seal fitting?

Swagelok Quick-Connect Fitting Installation in Boeing Airplane Company, Seattle, Wash., Test Facilities for Boeing 707 Jet Stratoliner.

Here's the secret of this fast, positive-seal Swagelok Quick-Connect Fitting!



1. Swagelok Quick-Connects with single end or double end shut off for tube to pipe, tube to tube, bulkhead tube to tube applications are available in brass and stainless steel in sizes for ¼" and ⅜" O. D. tubing.

2. Flow resumed instantly and vacuum tight seal assured when connection is made.

3. Light, compact, streamlined design. Occupies little space. For use with portable equipment, and bulkhead or panel applications.

4. Instant-acting seals completely prevent loss of pressure when fitting is disconnected.

5. No twisting, turning or wrench action necessary. Easy straight-line finger tip pull or push action for instant connecting or disconnecting.

In the Boeing Airplane Company photo shown above, the tubes are instrumentation pressure lines running from the large jet engines on test stands to the patch board, where the lines are coupled into measuring devices.

The Boeing Airplane Company adopted this positive Swagelok Quick-Connect Fitting to simplify test installations, and substantially cut down test set-up time. Both ends of the many pressure lines are Swagelok-equipped. Previously, engineers used a screw-type fitting which required a wrench and valuable time-consuming operations to tighten and remove.

Swagelok engineers are equipped with experience, ability, and a wide range of tube fittings designed to meet your individual problems. Quick delivery of Swagelok tube fittings from local distributor stocks.

Swagelok® TUBE FITTINGS

You are cordially invited to visit our Booth No. 921-923 at the 1960 Design Engineering Show

CRAWFORD FITTING COMPANY
884 East 140th Street • Cleveland 10, Ohio

Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada

Circle 1 on Time-Saver Card

Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

ACE PRODUCTS CO.

1820 N. 12th St. Toledo 1, Ohio
Est. 1935

AIRCRAFT COMPONENT DATA

Servo Valve Motor Unit . . . for ground, space

Servo valve modulates flow to motor producing speeds proportional to electrical input. Used to

control velocity and position of radar drives, missile guide vanes, reels, winches, flight controls, and stabilization devices. Servo valve weighs 0.53 lb; valve-motor package weighs 2.7 lb; volume is 60 cu. in. Models with integral relief valves weigh 2.9 lb with no additional length. For 10 to 20,000 rpm with maximum torque of 30 in-lb at 3000 psi. 8 ma differential current actuates valve control spool. Valve has a high linearity, low null shift with temperature, low hysteresis, and increased reliability by eliminating tubing and fittings.—*Vickers Inc., Detroit, Mich.*

Circle **506** on Time-Saver Card

Viton O-Rings . . . available in standard sizes

Design and Media Data booklet, 24 pages, describes Viton O-rings now available in all ARP (AN & MS) sizes as standard. Formerly available only out of regular tooling which produced undersized O-rings or as specials. Sizes cover all Viton compounds. Complete information, data, and dimensions contained in booklet.—*Parker Seal Co., Div. Parker-Hannifin Corp., Culver City, Calif.*

Circle **507** on Time-Saver Card

Hydraulic Fluid . . . for Titan missile launcher

Eight-page booklet describes properties and handling of Ucon hydraulic fluid M-1. Information on

Continued on page 150

NOW MINIATURE HAYDON PRESSURE SWITCHES

ADDED TO STANDARD 1500 SERIES ADJUSTABLE PRESSURE SWITCH LINE

(6 oz., 3-7/8" x 1-5/16")

1580 & 1880

The 1580 *Miniature Gage* Pressure Switch (4 ounces maximum, 3" x 1½") and the 1880 *Miniature Absolute* Pressure Switch (4 ounces, 3¼" x 1½") have SPDT or DPDT circuitry, with either sealed or unsealed snap-action switches. Operating pressure range: 0.5 psi to 3,000 psi. Operating media: Ammonia systems, freon, lubricating and hydraulic oils, aircraft fuels, radioactive water, oxidizers.

Write now for Bulletin 1580-1, which gives design specifications, electrical & environmental data, and applications.

HAYDON Switch INCORPORATED
WATERBURY 20, CONNECTICUT

Circle **78** on Time-Saver Card

TubeXperience in Action

9 REASONS TO CHOOSE SUPERIOR STAINLESS AIRCRAFT/MISSILE QUALITY TUBING FOR HYDRAULIC SYSTEMS

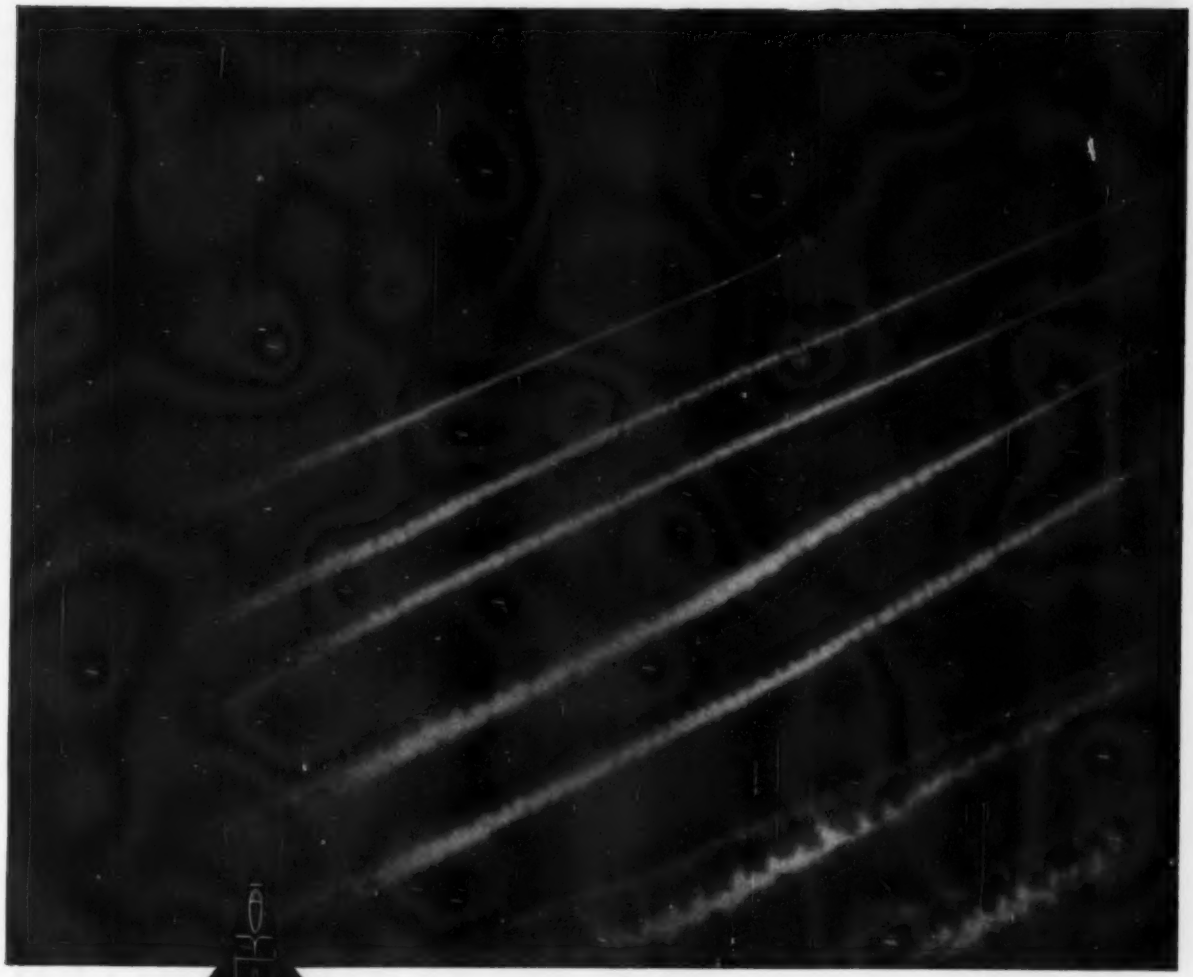
- Every length hydrostatically tested to recommended working pressure.
- Fully tested to assure flareability without surface notches or breaks.
- Controlled bending quality for ease of fabrication without distortion or fracture.
- Thoroughly cleaned to insure freedom from oxide film and foreign particles.
- Tolerances closer than generally required by industry specifications.
- Every length, down to 1/16 in. OD, indelibly marked with our name, specification, analysis, heat number and size.
- Certified test reports when required.
- Available in both seamless and Weldrawn® forms in Types 304, 321 and 347 stainless.
- Carried in stock by leading Steel Service Centers in sizes from 1/16 through 1½ in. OD.

FREE: "Tips on Stainless for Aircraft Hydraulics." Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube
The big name in small tubing
NORRISTOWN, PA.

All analyses .010 in. to ½ in. OD—certain analyses in light walls up to 2½ in. OD
West Coast: Pacific Tube Co., Los Angeles, Calif. • FIRST STEEL TUBE MILL IN THE WEST

Circle **153** on Time-Saver Card



Aviation

There are few industries which, for speed of evolution and progress, can be compared with the aircraft industry. The key to this rapid growth has been research, and it is in this field that 'VSG' variable delivery hydraulic pumps and transmission gears have played an important part not only in this country but overseas.

Test rigs of various kinds both for airframe and jet engine development have incorporated 'VSG' equipment as being most suitable for giving that precise control necessary to simulate the required conditions.

This is just another of the highly varied applications of 'VSG' which has now been serving modern industry for over fifty years.

'VSG'

Regd Trade Mark

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AUTOMATIC
HIGH OR LOW
Pneumatic
PRESSURE
SELECTION

with
New "Mite" 71

The "MITE" 71 can be easily field-changed, without special tools, from High-to-Low or Low-to-High signal selection. Hysteresis-free diaphragm assures rapid switch-over at minimum pressure differential.

- Rugged, simple construction
- One free-floating part
- Overall Dimensions — 2⅜" dia. X 2⅜" long
- Connections — ¼" NPT

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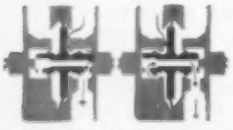
HIGH LOW LOW HIGH

SELECTING LOW SIGNAL
HIGH LOW LOW HIGH



For detailed information on the "MITE" Series, contact

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VALVES AND CONTROLS FOR THE COMMUNICATIONS, PROCESS, AIRCRAFT AND MARINE INDUSTRIES

Circle **50** on Time-Saver Card

AIRCRAFT COMPONENT DATA

viscosity-temperature relationships, effects on rubber and metals, results of pump tests, and physical properties. Meets severe operating conditions of Titan underground hard-sites. For —35 F to 160 F; liquid and vapor-phase corrosion inhibition; resistance to spray flammability in 100% oxygen atmosphere with electric arc ignition; resistance to detonation under 320 ft-lb/sq in impact in presence of LOX; and lubricity for rotary gear, vane, and axial piston pumps. *—Union Carbide Chemicals Corp., New York, N. Y.*

Circle **508** on Time-Saver Card

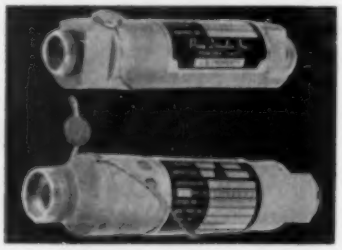
Bleeder Valves . . . permit visual check

For visual check of bleeding, slip clear plastic tube over discharge nozzle. Discharge port rotates 360 deg. Has knurled knob or slotted bleed screw. Safety wire holes. Made of 303 or 416 stainless steel. Burst pressure above 14,000 psi. Temperature range from —65 to 275 F. Three sizes have 5/16-24, 3/8-24, and 7/16-20 UNF mounting threads. Mate with AND 10050-2, -3, and -4 ports.*—Fluid Regulators, Inc. Painesville, Ohio*

Circle **509** on Time-Saver Card

Relief Valve . . . with low hysteresis

Fast action exceeds servo valve response. Can eliminate high pressure accumulator. Made in cartridge



and in-line types. Meets MIL-V-8813(ASG) specifications. For type I and type II systems.*—PneuDraulics Inc., Pomona, Calif.*

Circle **510** on Time-Saver Card

NEW! FROM UNITED

Metallic O-Ring Retainer Plates cut machining and assembly costs!

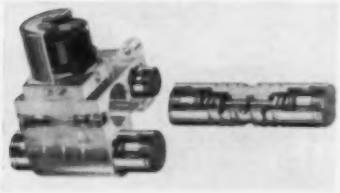
Now mating flanges can be sealed without machining grooves to hold metallic O-rings! United's metal retainer plates can be made for most junctures, regardless of the number of ports.

Openings in retainer plates function the same as groove walls. They furnish O-ring compression limit, control O-ring hoop tension, position O-rings for accurate matching of multiple hole patterns in mating flanges, and permit interchangeability of flanges. For price quotations, send flange drawing and specifications for fluids, pressures and temperatures to:

Circle **162** on Time-Saver Card

Servo Valve . . . for high inertia load systems

Derivative pressure feedback, electro-hydraulic, servo valve fea-

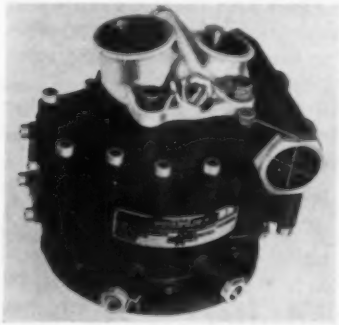


tures integral damping. For control systems where servo response is limited by load resonance. Valve functions as a flow controller statically, and is a pressure controller and flow controller dynamically. Dynamic characteristics obtained with load pressure feedback which is blocked statically by a hydromechanical phase lead network. Various ranges of system damping ratio and network break frequencies provided.—*Hydraulic Research & Mfg. Co., Burbank, Calif.*

Circle **511** on Time-Saver Card

Airborne Hydraulic Pump . . . for 3000 psi

Single-stage, variable-volume, cam-actuated pump with pressure compensation. Response characteristics meet or exceed MIL-P-7740B and MIL-P-19692. Volumetric efficiency is 95% through a pressure



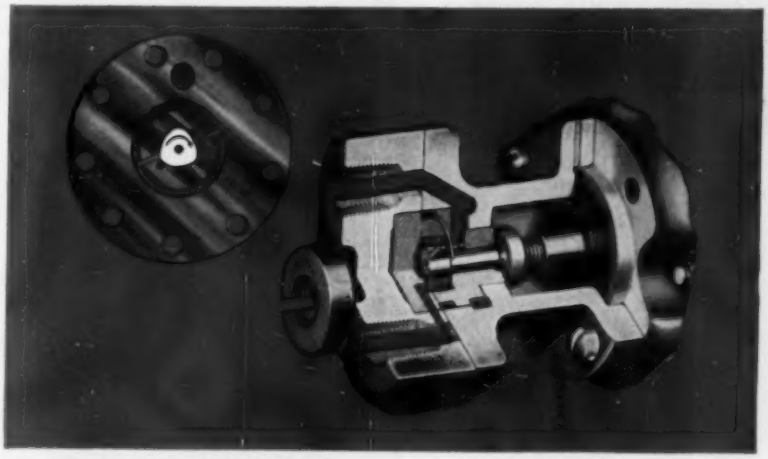
range to 3000 psi. Part No. AP10V delivers 27 gpm at 3750 rpm and 3000 psi. Weighs 17½ lb. All rotating parts hydraulically balanced. Pump does not require a universal drive nor antifriction thrust bearings. Direct oil entry permits greater periods of cavitation without noticeable wear. Accepts contaminants to 40 microns.—*Kellogg Division, American Brake Shoe Co., Rochester, N. Y.*

Circle **512** on Time-Saver Card

YESTERDAY'S PIONEER . . . TODAY'S LEADER

WELDON / FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

COMPACT • LIGHT WEIGHT

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

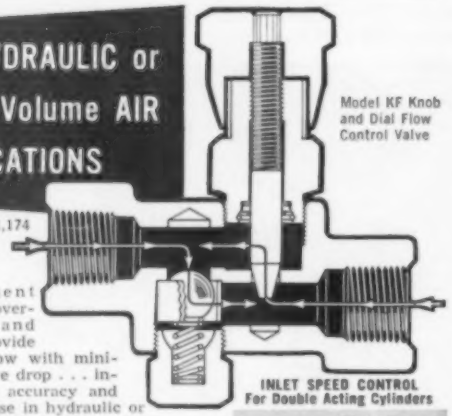
3000 WOODHILL ROAD . . . CLEVELAND 4, OHIO

Circle **175** on Time-Saver Card

AUTO-PONENT® VALVES | FLOW CONTROL, NEEDLE, CHECK

For HYDRAULIC or Large Volume AIR APPLICATIONS

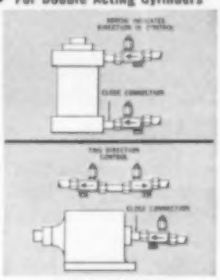
Patent #2,841,174



Model KF Knob and Dial Flow Control Valve

Auto-Ponent Valves with oversize ports and passages provide maximum flow with minimum pressure drop . . . insure greater accuracy and quick response in hydraulic or large volume air cylinder control. Self-aligning needle has unique Quad-Ring gland seal located at pressure port to seal off threads in needle housing, allowing needle to turn easily under maximum pressures. Gland structure and location also prevents air or dirt trapping in the housing. Flow Control and Check Valves have sensitive, chatterless ball check. Patented design insures rapid ball movement to open or close fully at low differentials. Made in 5 female Dryseal pipe sizes from ⅛" to ¾" inclusive. 3 Models: Standard, Knob and Dial, and Panel Mounting. Valve bodies are forged aluminum (3000 psi), steel or stainless steel (5000 psi). All internal parts are Stainless. Typical applications shown at right. Write for catalog AP59.

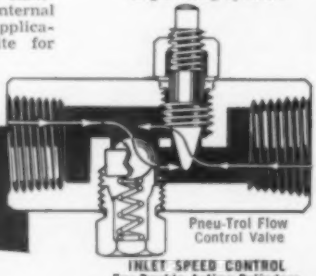
INLET SPEED CONTROL
For Double Acting Cylinders



SPEED CONTROL
Single Acting Cylinders

For AIR APPLICATIONS

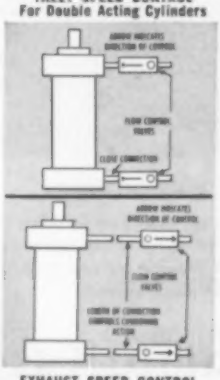
Patent #2,811,174



Pneu-Trol Flow Control Valve

INLET SPEED CONTROL
For Double Acting Cylinders

Pneu-Trol Flow Control, Needle, and Check Valves are widely used for air or small volume hydraulic cylinder control. Extremely compact design permits consolidated piping arrangements. Long tapered needle provides very sensitive and accurate air or oil flow control. Sensitive floating ball check opens or closes fully at slightest differentials. Valve bodies are machined from solid hexagon bars of aluminum or brass (2000 psi) steel and stainless steel (5000 psi). All internal parts are stainless steel. Made in 5 female Dryseal female pipe sizes: ⅛" to ¾" inclusive. Typical applications of Pneu-Trol Flow Control Valves are shown at right. Write for Pneu-Trol Valve Catalog No. 22.



EXHAUST SPEED CONTROL
For Double Acting Air Cylinder

AUTO-PONENTS INC.
2919 Grant St. • Bellwood, Illinois

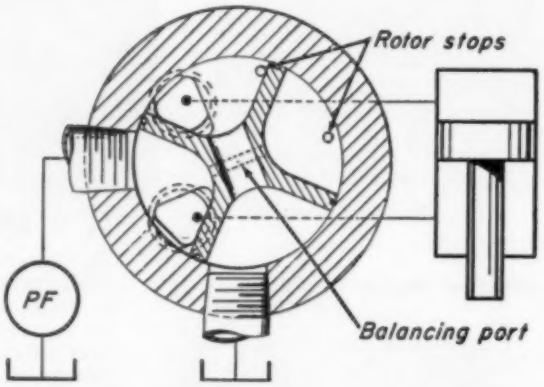
Circle 20 on Time-Saver Card

FLUID POWER PATENTS

Balanced Rotary 4-Way Valve

The feature of this control valve is low handle torque. Torque is reduced by balancing the pressure acting on the rotor.

With the rotor in the position shown, fluid enters the pressure port and is directed through the cylinder port to retract the cylinder. Fluid also passes through the balancing port to the other side of the rotor. This equalizes the pressure on both sides, balancing the



rotor. Fluid from the head end of the cylinder passes through the large port in the rotor to tank.

To extend the cylinder, the valve moves clockwise until it hits the stop. Fluid from the pump flows into the port to extend the cylinder. Equalizing pressure is again transmitted to the opposite side of the rotor through the balancing port.

A clearance of .002 to .004 in. between the rotor vanes and the valve body eliminates friction and seals, but allows some internal leakage.

U. S. Patent No. 2,907,349 *by Howard T. White, Melrose Park, Pa.*

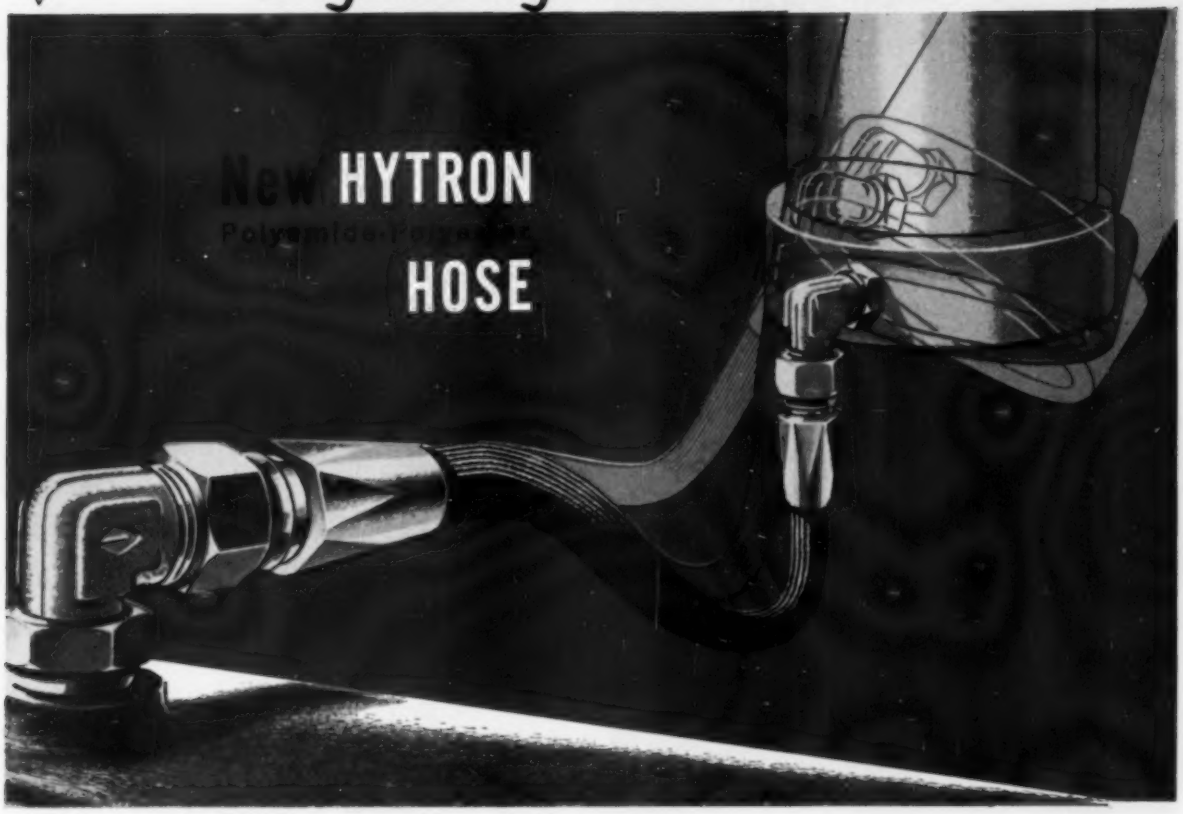
Pressure Intensifier

A compact pressure amplifier used in a closed hydraulic system, such as aircraft or automotive hydraulic brakes. It has two stages. Pressure fluid from an outside source passes directly through the amplifier until a set pressure is reached. At this point the second stage takes over and fluid outlet pressure from the amplifier is intensified.

• **Operation**—Fluid enters the intensifier through the inlet port, flows through the opening in the primary piston, and out through the outlet port. As pres-

Continued on page 154

IMPERIAL
Engineering and Data File



FAR GREATER FLEX-IMPULSE CAPACITY...
IMPROVED PRESSURE HOSE PERFORMANCE

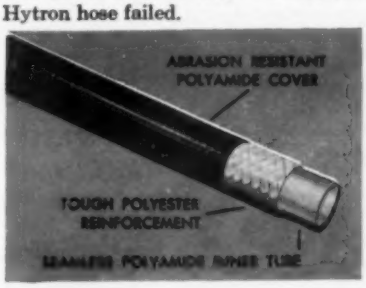
Imperial unveils a completely new concept in pressure hose — opening new opportunities in hydraulic and pneumatic circuitry design, bringing new economies and advantages to thousands of other hose applications.

Hytron was created to solve many of the problems encountered in using S.A.E. types 100R1 and 100R5 hose. It radically reduces hose size and weight, offering smaller O.D. for equivalent pressure capacity and I.D.

Flex-Impulse Test Results

Hytron superiority under punishing flex-impulse conditions has been clearly demonstrated. Comparable 24" lengths of hose with couplings were subjected to cycles from 0 psi to 3500 psi at one-second intervals. Simultaneously they were flexed at 60 times per minute.

After 57.4 hours the S.A.E. 100R5 single wire braid rubber hose burst near a coupling. It took 415.5 hours — *over seven times as long* — before the Hytron hose failed.



Note that there is *no wire braid* in Hytron hose. This eliminates one of the major causes of fatigue failure. Hytron is 80% lighter in weight, and, unlike wire braid rubber hose, retains virtually all of its flexibility under pressure.

Imperial Hytron hose operates in a burst pressure range from 9000 to 12,000 psi, depending on size and temperature. It is recommended for continuous service with fluids from −40 to 225°F, and for intermittent service to 250°F. Hytron is unaffected by nonflammable hydraulic fluids up to 180°F and flammable fluids up to 225°F.

Hytron hose is available in exceptionally long lengths. Furnished as factory-made assemblies, or with easy-to-install reusable couplings. Hytron couplings are of a new design that greatly minimizes flow restriction, offering up to 157% greater flow capacity.

IT'S IN THE BOOK

A new engineering report on Hytron hose and couplings contains detailed test results and performance figures. Send for your copy of Form No. NEPR-500 today.

THE IMPERIAL BRASS MANUFACTURING CO
Dept. AH-50, 6300 West Howard Street
Chicago 48, Illinois

NEW!

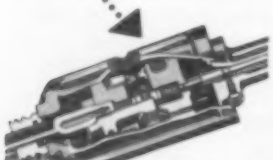
. . . DESIGN IDEA FOR PNEUMATIC POWERED DEVICES

. . . Put Humphrey Cartridge Type Insert Valves INSIDE YOUR PRODUCT

These Humphrey "Quick-Dump" Valves are installed by dropping them into a machined cavity, *inside* the cylinder, manifold, control handle, etc.

They save weight, cut material and component costs, reduce assembly time, speed up production. They eliminate the plumbing, permit installing multiple valves in small space, help simplify, miniaturize and clean up product design.

Choice of 2-way or 3-way, in ⅛" or ¼" sizes, for manual, electric or piloted operation. Write for bulletin pictured below.



Also — full line of conventionally mounted "Quick-Dump" Valves . . . manual, electric, piloted.

Humphrey PRODUCTS
Div. of General Gas Light Company
P.O. Box 2008, Kalamazoo, Michigan

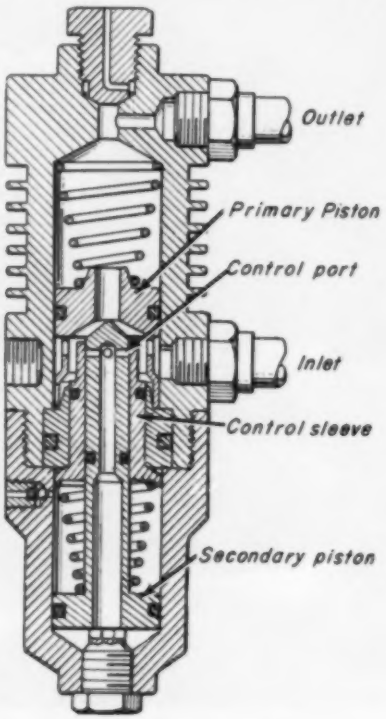
New Home of Humphrey Products

NEW bulletin gives engineering data on Cartridge Valves

Circle **83** on Time-Saver Card

FLUID POWER PATENTS

sure builds up, the control sleeve is forced down, opening the port in the secondary piston rod. Pressure fluid flows through the rod to the bottom of the piston and forces it up. It moves up until its stem closes the port in the primary piston. Incoming pressure then acts on



the bottom of both pistons, intensifying outlet pressure. Effective area of the secondary piston is greater than that of the primary piston. This gives a higher force on the secondary piston and keeps the port in the primary piston closed.

U. S. Patent No. 2,909,035 by Robert E. Mitton, assigned to Hydraflex Corp., Dallas, Texas.

Other Patents Issued

FLUID PRESSURE ACTUATOR

No. 2,905,199 by Earle S. Cook, assigned to Westinghouse Air Brake Co., Wilmerding, Pa.

REVERSING PUMP

No. 2,905,094 by Karl M. Gerteis, assigned to Carrier Corp., Syracuse, New York.

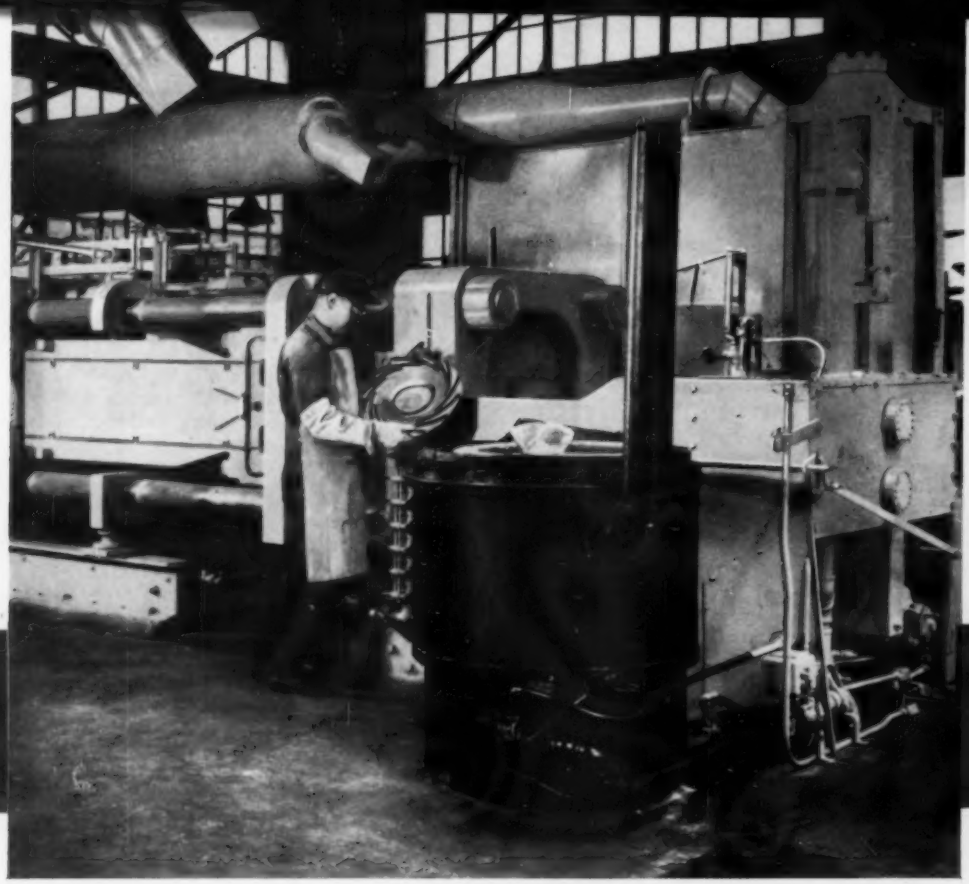
CHECK VALVE

No. 2,909,192 by Herbert O. Dobrick, assigned to Bendix Aviation Corp., Teterboro, N. J.

PRESSURE REGULATING-UNLOADING VALVE

No. 2,817,352 by Raymond J. Barton & Herbert J. Swarthout, assigned to Electrol Inc., Kingston, N. Y.

Circle **35** →



A 750-ton cold chamber die-casting machine at Alcoa's Garwood plant. Holding furnace in foreground containing molten metal is close to pressurized hydraulic lines.

Cellulubes promote safety at Alcoa

where hydraulic lines at 3500 psi pass near molten metal

The danger of fire due to line breaks has been held to a minimum at Alcoa's Garwood Works. In die-casting operations, Aluminum Company of America uses Cellulube fire-resistant hydraulic fluids in the hydraulic system serving the die-casting machines.

Although there have occasionally been line breaks under pressures ranging up to 2,000-3,500 psi, no serious fires have ever resulted. Alcoa has found that Cellulubes not only perform well as hydraulic fluids, but provide excellent lubrication of pump parts.

Cellulubes, the *safe* hydraulic fluids, are available in six controlled viscosities: 90, 150, 220, 300, 550 and 1000 SUS at 100°F. You can select the viscosity best suited to your operations. Cellulubes may well make an important contribution to the safety of your plant and personnel. Write to us for more information about Cellulubes. If you'd like a sample for evaluation, please let us know what application you have in mind.

Celanese® Cellulube®

Celanese CHEMICALS

CELANESE CHEMICAL COMPANY
a Division of Celanese Corporation of America
Dept. 588-E, 180 Madison Ave., New York 16, N.Y.

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16.

Pathon Series WAL...WHL

AIR AND LOW PRESSURE HYDRAULIC

Cylinders

You can improve the durability and appearance of your equipment with the new Pathon W Series Air and Low Pressure Hydraulic Cylinders.

Valuable space can be saved with these proven screw thread head units. They are available in all standard mounting types plus the type 8, intermediate flange mount (illustrated above) in bore sizes from 1⅛" thru 6".

Specify WAL for air or WHL for oil service to 200 psi. These economical units incorporate non ferrous barrels, hard chrome plated rods, and "U" cup rod packing for minimum friction.

Specify WAT for air service to 250 psi; or WHT for oil service from 350 to 500 psi, depending on bore size. These units incorporate hard chrome plated steel barrels, case hardened, chrome plated rods, and multi-lip rod packing.

All Pathon cylinders have externally replaceable rod packing.

Write for Bulletin #25

Pathon MANUFACTURING COMPANY

3823 PACIFIC AVE. • CINCINNATI 12, OHIO

A-59

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **128** on Time-Saver Card

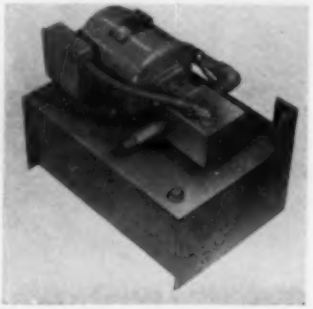
NEW PRODUCTS

Continued from page 72

POWER PACKAGE
. . . 1½ gpm at 2000 psi

Designation: Auto-Power

Features: For presses, machine feeds, lift tables, pushers, punchers. For intermittent or jog duty. Gear



pump coupled directly to motor. Built-in adjustable relief valves, ball check valves, and removable-screen, suction filters. Optional: solenoid-controlled, 1-way return valve with pressure-compensated flow control.

Specifications: Motor produces 3 hp at its duty rating.

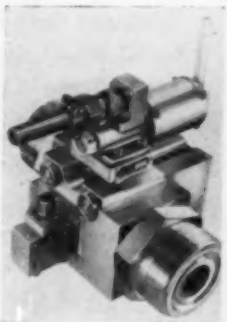
Autoquip Corp.
Chicago, Ill.

Circle **305** on Time-Saver Card

REMOTE-CONTROL AIR VALVE
. . . has manual override

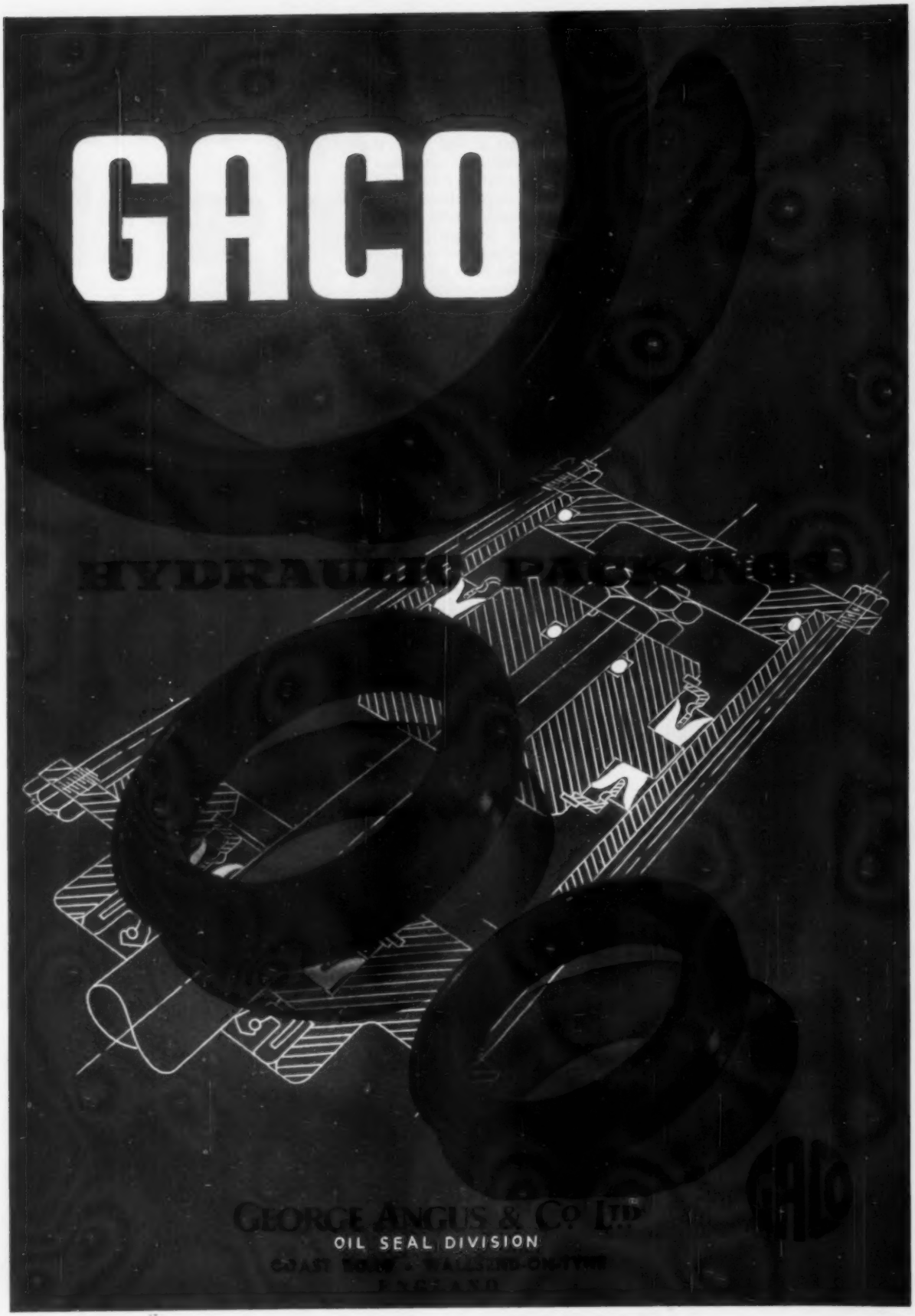
Designation: Model MV-173

Features: Controls 4500-psig air for blowing ballast tanks on atomic



submarines. Position switch indicates full open poppet position. NO or NC. Operates and seals with zero leakage, with pressure applied to either in or out port.

Continued on page 158


GACO
GEORGE ANGUS & Co LTD
OIL SEAL DIVISION

NEW PRODUCTS

Specifications: Line size, 1½" tube; operating pressure, 100-4500 psig; operating temperature, —65 to 160 F. Service: dry air or nitrogen. Operating voltage, 110-125 v. a-c.

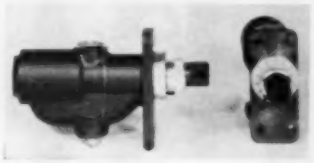
Marotta Valve Corp.
Boonton, N. J.

Circle **306** on Time-Saver Card

LOW FLOW RATE REGULATOR
. . . is pressure compensated

Designation: Model 1-4-2

Features: For drill press feeds, cylinders, test stands. High-strength, heat-treated cast aluminum body. Internal parts hardened steel, ground, lapped, honed, and selectively fitted. Panel or bracket mounting. Internal parts removed without disturbing piping. Built-in check valve gives free reverse flow. Flow adjustment changed without



flow rate of 90 cu. in. per minute. Pressure drop is 15 to 40 psi. Ports are ¼" NPT. Maximum operating pressure is 2000 psi. Requires 15 psi for regulated flow. Infinite flow adjustment in 330-deg. rotation. Positive stop at maximum flow. Needle can't blow out. Minimum recommended filtration is 40 microns.

Fluid Power Accessories, Inc.
Glenview, Illinois

Circle **307** on Time-Saver Card

PRESSURE GAGES
. . . all stainless steel

Features: Useful in corrosive atmospheres and media. Bourdon tube design. Meets ASA Grade B

specifications, including 2% accuracy at middle (working half) and 3% for remainder of dial.

Specifications: Available in standard ranges up to 5000 psi and in dial sizes of 2", 2½", and 3".

United States Gauge Div.
American Machine and Metals, Inc.
Sellersville, Pa.

Circle **308** on Time-Saver Card

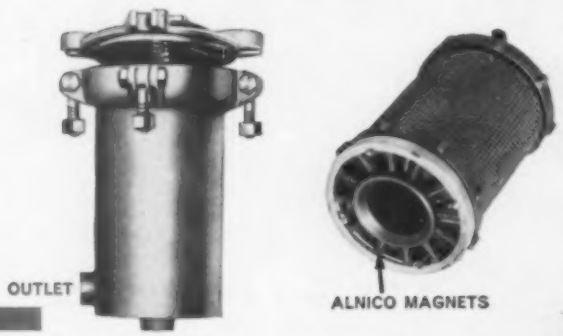
AIR SLIDE VALVES
. . . are pilot operated

Designation: SP-125, button. SPB-125, ball. SPH-125, knob. SA-125, safety bleeder.

Features: Eliminates use of solenoids. Pilot valves are: nose-mount, straight thrust button type; ball-

Continued on page 160

GET THE *ADDED PROTECTION* OF MAGNETIC SEPARATION WITH THIS BASKET-TYPE STRAINER



Nugent now manufactures a line of basket-type strainers offering the added protection of magnetic separation. Specially designed Alnico magnets establish a magnetic field through which the strained liquid must pass as a final stage before leaving the unit. Thus, minute ferrous particles are trapped and removed from the fluid stream.

If you have valuable engines or other equipment which demands top-notch lubrication protection, it will pay you to get the full story on the Nugent combination strainer-magnetic separator.

Write today . . . no obligation, of course.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.
3432 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Circle **120** on Time-Saver Card

The long and short of it is... this

TOWLER 500 H.P. DOUBLE AXIAL PUMP . . .

operates on the well proved Towler axial principle. Performance 500 HP when driven at 1200 RPM Working Pressure 5500 PSI with a delivery of 142 US gallons per minute.

This pump is compact and occupies little space; it requires no maintenance and all wearing parts are replaceable.

TOWLER BROTHERS

(PATENTS) LTD.,
RODLEY, LEEDS, ENGLAND

ELECTRAULIC
PUMPS
CONTROLS
AUTODRAULIC

CANADA AND U.S.A. AFTER SALES SERVICE
Walter Miller,
1770 Jane Street, Weston,
Toronto, Ontario, Canada
Telephone CHerry 1-9128

A member of
the Metal Industries Group of Companies

8th Annual Competition

1960 FLUID POWER PRIZE PAPER CONTEST

Articles about:

HYDRAULIC AND PNEUMATIC SYSTEMS AND COMPONENTS

DESIGN • APPLICATION • MAINTENANCE

FIRST PRIZE	$500
SECOND PRIZE	$300
THIRD PRIZE	$200
4th to 7th PRIZES, EACH	$100

All prize papers will be published in APPLIED HYDRAULICS & PNEUMATICS Magazine. Papers receiving honorable mention awards will also be published and paid for at regular rates.

CONTEST CLOSES JULY 1, 1960

Committee of Judges:

J. A. Draxler, Chief Engineer, Elwell-Parker Electric Co.

R. K. Sedgwick, Assistant Chief Engineer, Servo Machine Tool Div., Kearney & Trecker Corp.

W. E. Mayhew, Staff Engineer, Advanced Fluid Systems Research & Development, Republic Aviation Corp.

SPONSORED BY APPLIED **Hydraulics & Pneumatics**

An Industrial Publishing Corporation Magazine

812 HURON ROAD, CLEVELAND 15, OHIO

Circle **240** on Time-Saver Card

NEW PRODUCTS

operated, eliminates plunger destruction by side-wipe thrust; knob-operated on panel or machine operating station; miniature button-operated is safety auxiliary unit. Easily repaired, uses standard O-rings.

Airelectric Corp.
Melrose Park, Ill.

Circle **309** on Time-Saver Card

STAINLESS STEEL FILTER . . . in 6"-18" lengths

Designation: Star S-78

Features: Large surface area per volume. High flow rates, low pressure drops. Quick-opening housing keeps contaminant from going

downstream of filter. When filter is cleaned, housing and element are removed downward.

Specifications: Housing has 4" diameter. For pressures from full vacuum to 125 psig, temperatures to 300 F. 6" unit for flow rates to 5 gpm or 60 cfm at pressure drops of 2 to 3 psi. Ratings to 2 microns.

Micro Metallic
Div. Pall Corp.
Glen Cove, N. Y.

Circle **310** on Time-Saver Card

PLUG-IN LIMIT SWITCH . . . functions as two switches

Designation: 301LS1

Features: Contains two, 2-circuit, double-break switches. Can control four circuits. Roller-lever actuator moves to left and right. Can be oil-tight. Saves time, space, wiring, simplifies actuating systems.

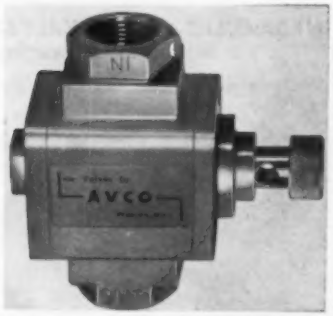
Micro Switch Div.
Minneapolis-Honeywell Regulator Co.
Freeport, Ill.

Circle **311** on Time-Saver Card

SHUTOFF & BLEED VALVE
. . . has snap action

Designation: Loc-Master

Features: For air and hydraulic supply lines. Compact, aluminum-alloy



body. Unrestricted flow. Quarter-turn of thumb nut stops line pressure, bleeds downstream pressure. Hole in stem for padlocking closed.

Specifications: For 0 to 150 psi. Fits ⅜", ½", and ¾" lines.

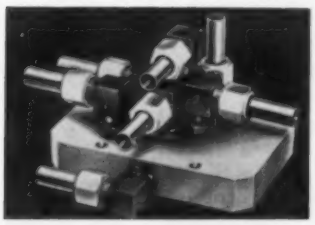
Air Valves Co.
Warren, Mich.

Circle **312** on Time-Saver Card

METAL-TO-METAL FITTING
. . . needs no swing clearance

Designation: Self-Seat

Features: Reduces installation time in hydraulic, pneumatic systems. Has straight thread. Consists of stem and body with a floating nut. Tightening nut forces stem to coin its own seat. Useable in confined space because body does not turn



when nut is tightened. Simple installation without special tools. Leakproof without O-ring.

Specifications: Sizes ½" to 2" OD in conventional shapes, with self-flare, standard, and flare connections.

The Flodar Corp.
Cleveland, Ohio

Circle **313** on Time-Saver Card

750-PSI AIR CYLINDERS
. . . have low friction

Designation: Model A

Features: Higher ratings don't affect low-pressure operation. Pressure-sealing seals. Teflon static seals. Case-hardened, hard-chrome-plated piston rods. Rust-resistant surfaces. Solid steel heads, caps, and mountings.

Specifications: Pressure ratings: 1½" and 2" bores, 750 psi; 2½" bore, 500 psi; 3¼" bore, 750 psi; 4", 5", and 6" bores, 400 psi; 8", 10", 12", and 14" bores, 250 psi.

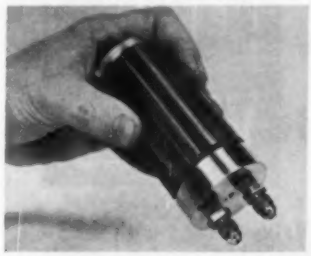
Miller Fluid Power Div.
Flick-Ready Corp.
Bensenville, Illinois

Circle **314** on Time-Saver Card

MICROMETER CONTROL VALVE
. . . has linear flow change

Designation: Model F4.

Features: Flow adjustment based on length of flow passage, not on area as with needle valve. Reduces possibility of clogging. Serves as variable damping passage in elec-



trohydraulic servo system. Also usable in on-off systems where water hammer is problem.

Specifications: 5" x 2" diameter. Regulates flow from 10 to 100 cc/min in 15 turns, increases to 1150 cc/min in 9 turns more.

Sanders Associates, Inc.
Nashua, N. H.

Circle **315** on Time-Saver Card

RETAINING RINGS
. . . new package size

Designation: Truarc Snap-Pak

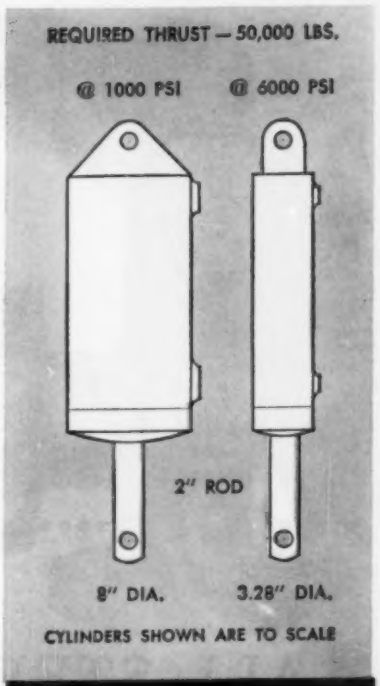
Features: Envelopes contain 2 to 35 rings according to size in 118 diameters. Dust-free, reuseable and

completely identified to facilitate selection and service. For small quantity users. Envelopes 3½" x 4".

Waldes Kohinoor, Inc.
Long Island City, N. Y.

Circle **316** on Time-Saver Card

Continued on page 162



HIGH PRESSURE IS
COMPACTNESS

Component size reduction provides the greatest gain in going to higher pressure systems. For example, a 3¼" diameter cylinder will do the work of an 8" diameter cylinder if the relative pressures are 6000 PSI and 1000 PSI (shown above). Since less oil has to be transmitted to do a given job, the line sizes are dramatically reduced, as is the oil reservoir, valving, etc. Since size and weight are usually directly proportional, the comments applied to size, in general, hold for weight. Very sizeable reductions in the weight of cylinders are encountered since they are so much smaller.

DYNEX INC.
A DEVELOPMENT OF BLACKHAWK
IS HIGH PRESSURE
777 DYNEX DRIVE • PEWAUKEE, WISCONSIN
HYDRAULIC PUMPS • VALVES • MOTORS • CYLINDERS • CIRCUITS

Circle **56** on Time-Saver Card

EXTRA SAFETY EXTRA SERVICE

fulflo VALVES

ALL STEEL

for *positive* AUTOMATIC PRESSURE CONTROL

The combination of FULFLO Valve design with ALL-STEEL construction is outstanding when you're looking for safe, trouble-free and quiet operation in any hydraulic system.

FULFLO design offers shear-closing action to eliminate chattering; sliding piston for full flow opening; easy adjustment within the pressure range or change of the pressure range.

ALL-STEEL construction adds extra safety, maximum protection against fire or mechanical damage demanded by hydraulic designers and users . . . to the advantages proved by literally thousands of FULFLO all-brass or stainless trimmed valves.

Whatever your requirements . . . for O.E.M. use or replacement service . . . there's a FULFLO Valve designed just right, built right and priced right.

- **Screw or flange models . . . to 500 lbs. . . . pipe sizes to 3"**
- **Steel, cast or brass bodies . . . brass, steel or stainless trim**
- **Just 6 springs for complete range of pressures**
- **Fast shipment of standards . . . specials to your requirements**

Need a "special"?

FULFLO can engineer a special valve to your most exacting specifications . . . and deliver faster than you may think possible.

FOR COMPLETE INFORMATION,

request a copy of 1960 FULFLO Valves Mechanical Data Book.

FULFLO **THE FULFLO SPECIALTIES CO., INC.**

415 Fancy Avenue Blanchester, Ohio

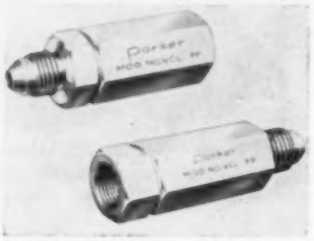
Circle **63** on Time-Saver Card

NEW PRODUCTS

HYDRAULIC CHECK VALVES . . . for in-line mounting

Designation: Series VCL-PF and VCL-FP.

Features: Internal pipe thread port in one end and JIC flared tube



connection at other end. For 3000-psi operating pressure.

Specifications: Flow ratings of 3, 6, 11, 20, 28, 50 gpm. Opening pressure of 6 and 65 psi in each size.

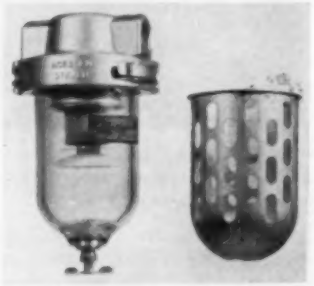
Parker Hydraulics Div.
Parker-Hannifin Corp.
Cleveland, Ohio

Circle **317** on Time-Saver Card

AIR FILTERS . . . have four parts

Designation: Series 30 BE

Features: Filters remove all liquid. Improved baffling. Plastic bowl has higher safety factor, holds 53% more liquid. No tools needed to take apart: open spring clip on clamp ring, remove clamp ring, pull



off bowl. Unscrew baffle which holds element, and remove element. Air passages through filter are larger than pipe's internal area.

Specifications: For pipe sizes ¼", ⅜", ½". Elements for 74 microns (standard), 64, 25, or 5 microns.

C. A. Norgren Co.
Englewood, Colorado

Circle **318** on Time-Saver Card

Continued on page 164

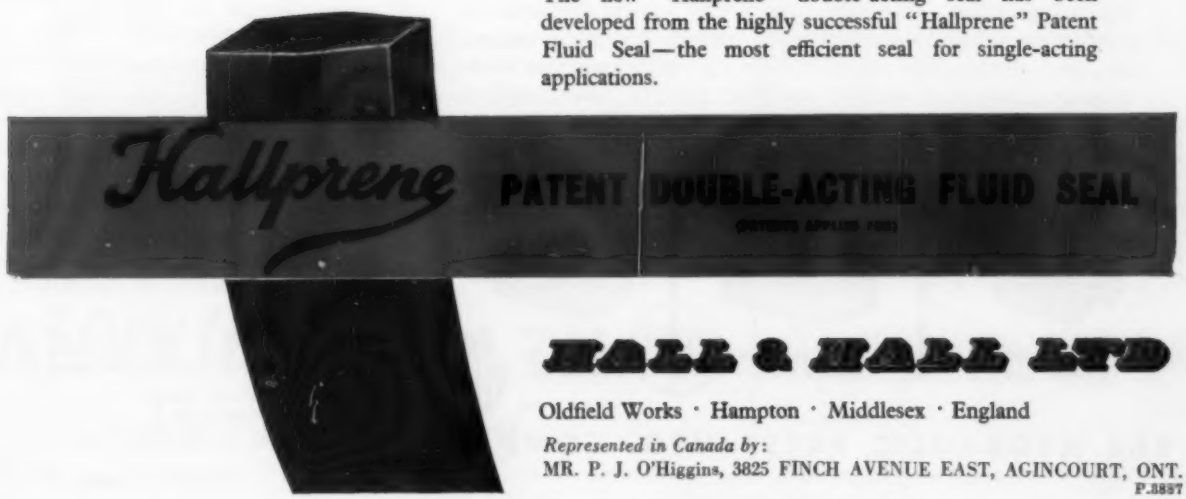
at last...

an *effective one-piece* double-acting seal!

Specially designed for double-acting cylinders—the new "Hallprene" Patent Double-Acting Fluid Seal.

- ✳ Improves sealing
- ✳ Prevents the possible formation of fluid traps
- ✳ Reduces costs
- ✳ Simplifies piston design
- ✳ One seal replaces two

The new "Hallprene" double-acting seal has been developed from the highly successful "Hallprene" Patent Fluid Seal—the most efficient seal for single-acting applications.



HALL & HALL LTD

Oldfield Works · Hampton · Middlesex · England

Represented in Canada by:
MR. P. J. O'Higgins, 3825 FINCH AVENUE EAST, AGINCOURT, ONT.

P.3857

NEW PRODUCTS

AIR TOOLS
. . . combine linear, rotary motion

Designation: 21K, 21L Series.

Features: For drilling, tapping, fastening, grinding, reaming, counterboring, and wire brushing. Graduated external sleeve is rotated to adjust stroke. 21K series has spring return. Double-acting

air cylinder retracts 21L series. Needle valve, in standard head, controls feed with no effect on spindle rpm. Stroke control package—rods, contact plates, front and rear pilot valves (or micro switches)—mounts anywhere on exposed piston rod. Hydraulic head available with 21L series. Has built-in reservoir with visual indicator. Control valving separate from tool.

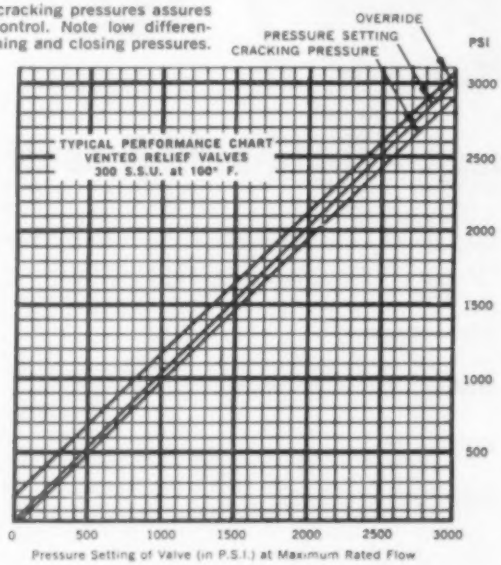
Specifications: Motor from 650 to 22,000 rpm. Tools weigh from 4⅜ to 6 lb. Lengths from 16¾" to 23 3/16".

Buckeye Tools Corp.
Dayton, Ohio

Circle **319** on Time-Saver Card

Take A Long, Close Look
AT THE NEW H-P-M RELIEF VALVES

Close control of cracking pressures assures accurate cycle control. Note low differential between opening and closing pressures.



The performance chart tells the complete story: Close control of cracking pressures; choice of high or low venting pressures to match your system requirements; low override for system protection and trouble-free operation. They're interchangeable with industry standards. Available in ⅜", ¾" and 1¼" sizes, subplate mounted, 3000 psi, 0 to 65 gpm.
THE PRICES ARE COMPETITIVE.

⅜" Relief Valve
3000 psi, 6 gpm

¾" Relief Valve
3000 psi, 20 gpm

1¼" Relief Valve
3000 psi, 65 gpm

HPM

H53

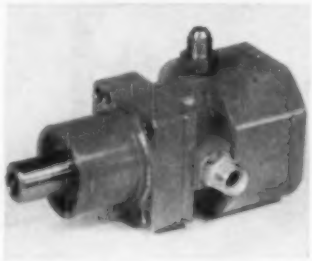
THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **86** on Time-Saver Card

AXIAL PISTON PUMPS
. . . to 5000 psi

Designation: 1A4.

Features: Adaptable to variable or fixed stroke, permits wide range



of flows. Usable as hydraulic motor.

Specification: 3.73 gpm delivery at 5000 psi, 3600 rpm. To 8000 rpm as motor, 5000 rpm continuous. Weight 7 lb.

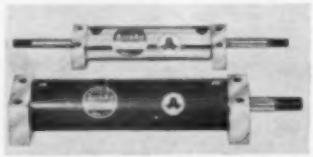
Lucas-Rotax Limited
Toronto, Ontario, Canada

Circle **320** on Time-Saver Card

AIR & OIL CYLINDERS
. . . choice of packings

Designation: Type AS

Features: Double-acting or spring-return. Single or double-ended. One-piece or square heads. Ground



and polished stainless steel rods. Nylon bearings. Honed brass or steel tubes. Cushions are optional.

Specifications: Bore sizes are ⅞", 1⅛", 1½", and 2". Strokes to 20" in stock. Strokes to 168" available.

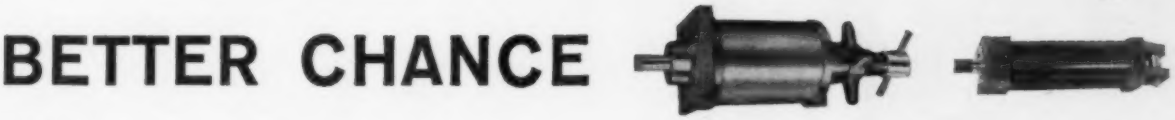
Allenair Corp.
Mineola, N. Y.

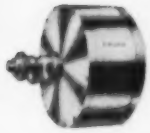
Circle **321** on Time-Saver Card

Continued on page 166

YOU HAVE A

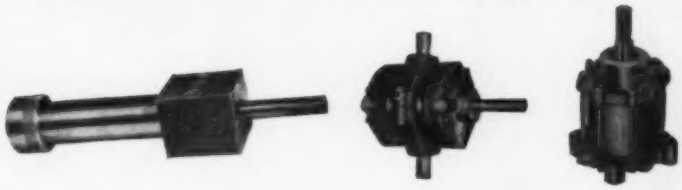
BETTER CHANCE





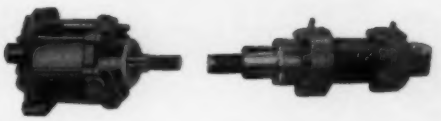
OF FINDING THE EXACT

POWER CYLINDER YOU NEED IN



A STANDARD

PRODUCTION MODEL



AT ANKER-HOLTH

HERE'S WHY:

Anker-Holth makes the world's widest selection of standard power cylinders. That means that you have a better chance of finding the exact cylinder when you call on us for your power needs. Anker-Holth standard cylinders, built to JIC specifications with bores of 1 to 30 inches and strokes to 40 feet, are time-tested and experience-proved in every major industry. Nine complete lines are offered and all mountings are available.

This free catalog shows all our standard production models. Send for it today.

Send this

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES

80A1-1

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING COMPANY
2723 CONNOR STREET. PORT HURON, MICH., U. S. A.
D-1

Name_____

Company_____

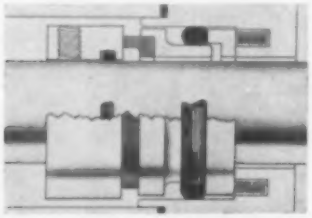
Address_____

_____

NEW PRODUCTS

SPRINGLESS SEALING
. . . pressure replaces springs

Features: Balanced fluid pressure gives positive sealing, eliminates uneven face wear. For use in wide range of fluid service. Conventional rotary mass replaced by a single ring. Designed for installation by



maintenance men. One design for all pressures. No sleeve or shoulder for high pressure. Springs used only to keep deep carbon faces in contact when not operating.

A. W. Chesterton Co.
Everett, Mass

Circle **322** on Time-Saver Card

AIR-OPERATED C-CLAMPS
. . . in two series

Features: Heavy-duty and economy series. Available with manual sleeve or integral solenoid valve. Various

power factors and clamping ends available. Tailored to any industrial application.

Specifications: Openings adjustable to 6", 7", 8", 9". Clamp shown has ¾" depth. Cylinder has 7:1 power factor.

Airmatic Valve, Inc.
Cleveland, Ohio

Circle **323** on Time-Saver Card

PORT CONTOUR CUTTERS
. . . meet AND specifications

Features: Cutters are carbide tipped, have solid, heat-treated, tool steel bodies, are end piloted. Spot face diameter is larger than conventional standard AND cutters and will machine larger bosses. Also provides extra diameter for special grinds.

Specifications: For ⅛" through 2" tubing.

Wetmore Tool & Engineering Co.
Los Angeles, Calif.

Circle **324** on Time-Saver Card

PRESSURE GAGE CONNECTOR
. . . revolves gage in any direction

Features: Pressure gage threads into connection which rotates at the top.

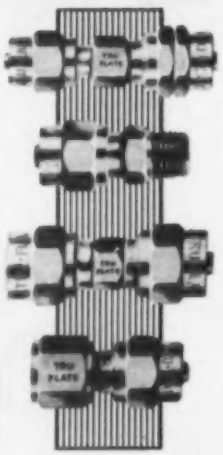
Allows gage to be turned easily without tightening or loosening threaded connector. Offers flexibil-

Continued on page 168

TRU-FLATE

REUSABLE
HOSE FITTINGS
for every industrial application

Popular Reuseable "Screw-On" type hose fittings for Air, Water Gas, Oxygen, Acetylene, etc., with thread sizes ⅛" NPT to ¾" NPT for hose with 5/32" I.D. to ½" I.D. Most sizes available in brass or steel. Can be easily and quickly assembled without special tools.



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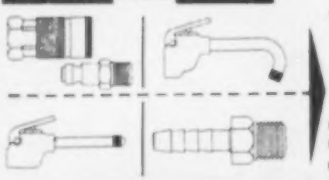
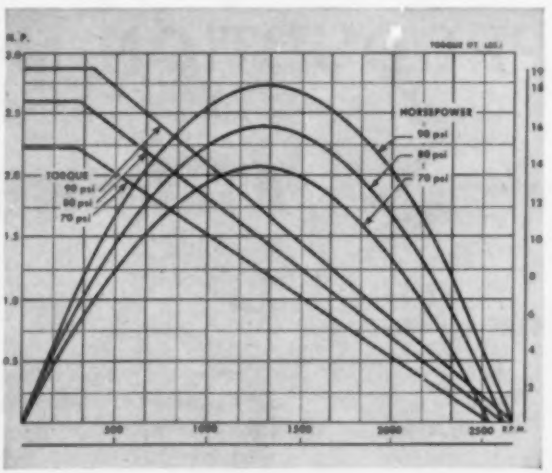


- Other *Tru-Flate* Products
- Couplers and Nipples
  - Sleeve Type Series
  - "Push" Type Series
  - Interchange Series
  - Hydraulic Series
  - "Strait-Thru" Series
- Reuseable Hose Fittings
- Barb Type Hose Fittings
- Blow Guns, Water Valves

TRU-FLATE, INC.
888 - 92ND AVENUE • OAKLAND 3, CALIFORNIA

Circle **160** on Time-Saver Card



EFFICIENT OPERATION. Axial-piston air motors are available from 0.6 to 2.7 hp. Power curve illustrates performance at varying air pressures.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW
Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

GARDNER-DENVER

Circle **66** on Time-Saver Card

Circle **33** on Time-Saver Card

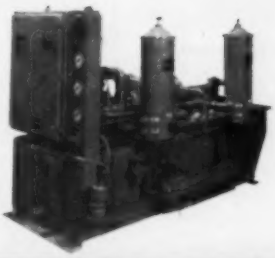
CARDWELL

Trademark
SINCE 1829

CUSTOM ENGINEERING IN INDUSTRIAL HYDRAULICS

Design and fabrication of power units, hydraulic or electrical control panels, and accumulators. Stocking distributors for leading hydraulic components.

Talk over your special needs with the Cardwell Service Engineer in your area.

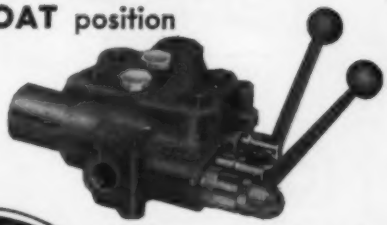


The CARDWELL MACHINE COMPANY
Quality — A CARDWELL TRADITION SINCE 1829
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

DIRECTIONAL CONTROL

with **FLOAT** position

MODEL WPK



GRESEN HYDRAULICS

NEW 2-spool parallel valve for snow plows, dozers, loaders, graders and similar mobile equipment.

FIRST SPOOL has four (power-neutral-power-FLOAT) positions. It is spring loaded to neutral, but has a detent in the FLOAT position.

SECOND SPOOL is conventional 3-way or 4-way as required, spring loaded to neutral.

BOTH SPOOLS have separate ball checks—are self centering, fully balanced and accurately feathered for fine metering action.

RELIEF VALVE is cartridge type with hardened seat.

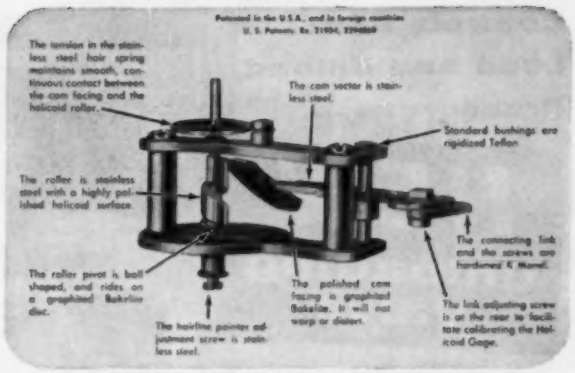
TRIPOD MOUNTING feet make installation easy.

CAPACITY—40 GPM at 20 ft./sec.

MAX PRESSURE—1500 psi.

WRITE FOR LITERATURE **GRESEN** *Mfg. Co.*
405 35th Ave., N.E., Minneapolis 18, Minn.

Circle **71** on Time-Saver Card


Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21904, 2394869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides *Sustained Accuracy* ...on the toughest jobs!

• Helicoid Gages have no gears, no teeth—wear is reduced to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Even when subjected to violent pressure pulsations or mechanical vibrations, Helicoid Gages *stay* accurate. Only Helicoid Gages provide *all* these advantages:

Sustained accuracy—Helicoid movements have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy. Conventional *geared* gages on the same test became useless after only 500,000 cycles.

Durability—Bourdon tubes won't stretch, leak or crack. Dial faces won't corrode or chip.

Wide selection—Gages are available for practically any application from tap water to acid. Gages include flanged and flangeless, round and square, in standard and flush-mounting models. Accessory equipment includes gage cocks, needle valves, siphons and snubbers.

NEW! Solid-Front Safe-T-Case Gage

This new Helicoid design diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming the back cover plate, which can then be replaced inexpensively.

Write for Catalog DH-65 for details on the complete line of Helicoid Gages

Distributed in Canada by Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

HELICOID GAGES

ACCO

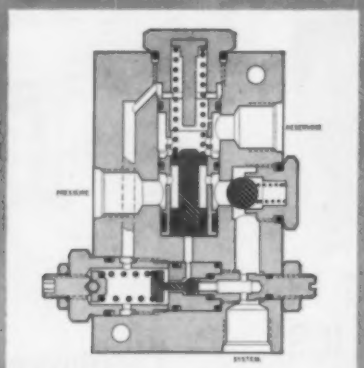
Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

Circle **80** on Time-Saver Card

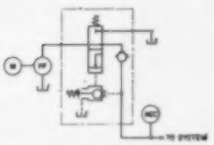
Circle **60** on Time-Saver Card

Controls Both Load And Unload Pressures . . .

NEW Unloading Valve



Size — ½" SAE Ports



Typical Accumulator Circuit

Exclusive Features . . .

- Unload pressure adjustable — from 800 to 3,000 psi.
- Load pressure independently adjustable — 5% to 20% differential.
- Positive snap action — assures complete loading and unloading.
- Built-in check valve and integral pilot save money.

Applications . . .

- Accumulator Circuits
- Two-Pump, Hi-Lo Circuits
- To Vent Relief Valves

Write for detailed literature

Fluid Controls, inc.

Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

NEW PRODUCTS

ity and space saving for close hook-up where space is a premium. Double exposure photograph shows gage in two positions.

Specifications: For standard pressure gage connections.

Macco Oil Tool Co., Inc.
Houston, Texas

Circle **325** on Time-Saver Card

CARBON-FILLED TEFLON PISTON RINGS . . . for low friction

Features: Lower coefficient of friction than any other solid material. Use when you can't to lubricate, when you must save space and weight, when corrosion is pres-

Continued on page 170

AIR-MITE AIR CYLINDERS

★COMPACT ★POWERFUL ★RUGGED ★LOW COST

AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:

1. Ground and polished steel ram
2. Bronze oilless ram bushing
3. High strength aluminum alloy cylinder heads
4. Brass, true-bore cylinders
5. Five steel tie rods

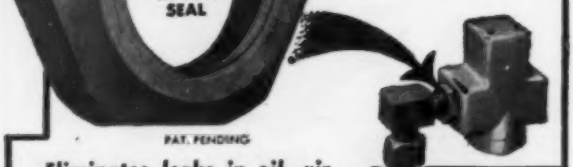
AIR-MITE DEVICES, INC.
3101 W. Kinzie St., Chicago 24, Ill.

Circle **8** on Time-Saver Card

TRU-SEAL

TEFLON SEAL

Saves hours in piping installations

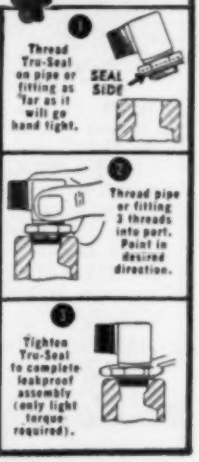


PAT. PENDING

Eliminates leaks in oil, air, water, vacuum, chemical lines

Tru-Seal saves hours in assembling piping installations because it enables you to run your pipe lines in any direction you wish, quickly and easily—without having to recut and re-thread piping sections. Wherever used on air, oil, water, steam, vacuum or chemical lines, it seals perfectly at —100° F. to plus 500° F.—*without the use of pipe dope.* Its installation requires only light tightening torque, thus eliminating over-tightening damage to valves, pumps, compressors, and other fittings.

For further information write


1
Thread Tru-Seal on pipe or fitting as far as it will go hand tight.
SEAL SIDE
2
Thread pipe or fitting 3 threads into port. Point in desired direction.
3
Tighten Tru-Seal to complete leakproof assembly (only light torque required).

TRU-SEAL DIVISION
FLICK-REEDY CORPORATION
7N017 York Rd., Bensenville, Ill.

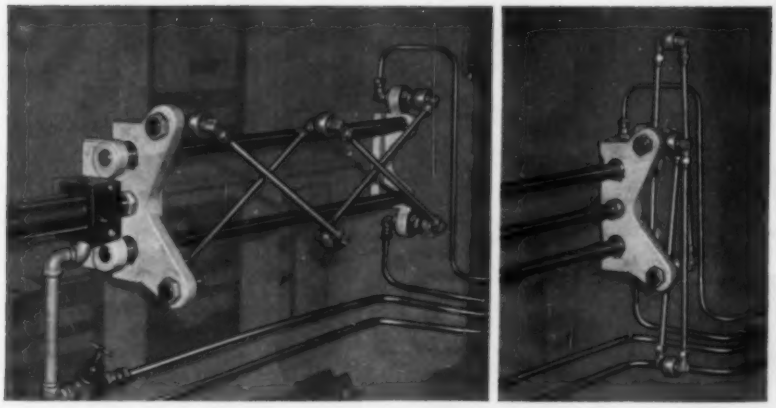
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

Circle **161** on Time-Saver Card

IN EQUIPMENT DESIGN ■

CHIKSAN SWIVEL JOINTS

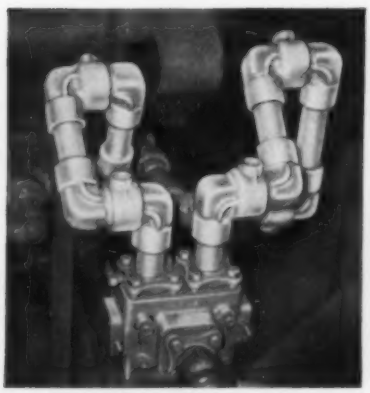
SMOOTH OUT KNOTTY LINE PROBLEMS



STEEL LINES FOLD LIKE AN ACCORDION

Connected to a moving head, these compact swivel jointed all-metal hydraulic lines flex and fold like an accordion on this automatic bottle unpacking machine.

When a machine's moving parts cause tight bend or twist on hose lines, Chiksan Swivel Joints provide a ready solution. When design dictates the use of metal lines, Chiksan Swivel Joints allow rubber-like flexibility. In fact, wherever line flexibility is required, designers and maintenance engineers know it's just good business to call on Chiksan. Precision made Chiksan Swivel Joints with their infinite service life, full 360° rotation and high safety factor, quickly pay for themselves by minimizing hose replacement and eliminating costly line failure, fluid loss and downtime. If your equipment hose lines require frequent replacement due to torsion or bend radii fatigue, or if flexible all metal lines are in order, contact Chiksan. A nearby representative will call, analyze your requirements, and make specific recommendations. Write today for his name.

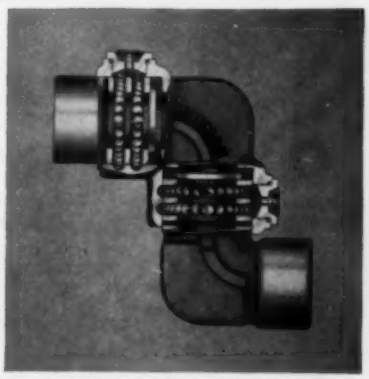


NO HOSE BURST HERE

These Chiksan swivel jointed steel lines on a die casting machine eliminate damaging hose ruptures, reduce fire hazard, fluid loss and setup time by 75%.

NO BEND FATIGUE HERE

This highly specialized lens grinder utilizes Chiksan Swivel Joints to eliminate tight hose bend as the multiposition head is shifted from one grinding position to another.



LOOK INSIDE A SWIVEL JOINT

Detailed attention to detail. Precision machining and specific packing seals for specific services. These are the quality-plus features built into every Chiksan Swivel Joint.

CHIKSAN

fmc A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Company • Chiksan of Canada, Ltd.

Circle **40** on Time-Saver Card

NEW PRODUCTS

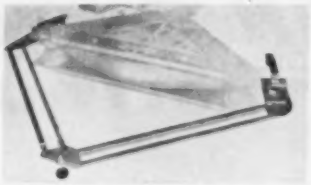
ent. Tough, abrasion-resistant. Imbeds hard, foreign particles with no adverse effect on cylinder or ring. Use matched rider rings with these rings if long stroke or heavy pistons demand more support.

Garlock Inc.
Palmyra, N. Y.

Circle **326** on Time-Saver Card

PIPE BENDING INDICATOR
. . . fits any pipe bender

Designation: No. 1807



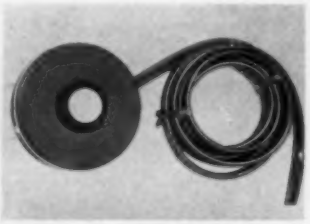
Features: Useable for ½" to 6" pipe or conduit, fits benders operating in horizontal position. Pipe need not be removed to determine degree of bend.

Greenlee Tool Co.
Rockford, Ill.

Circle **327** on Time-Saver Card

PRESSURE REGULATOR
. . . is foot-operated

Features: Pressure on rubber tread controls air and vacuum to 125 psi. Rubber base protects floor, keeps unit from sliding. Self-relieving. Comes with 10' of plastic tubing to connect to supply and output lines. Nylon or metal braid tubing



available. For dead-end test work, or speed control of pencil-type air tools.

Specifications: Flows to 2 cfm. 5" diameter, 1 11/16" height.

Air-Specialty Co.
Baltimore, Md.

Circle **328** on Time-Saver Card

HYDRAULIC POWER UNIT
. . . self-contained, portable

Designation: Dyna-Pack 110.

Features: Self-centering, spring-loaded valve handle. Combination valve operates both single-acting and double-acting cylinders. Gear

pump. Plugs into 110-volt outlet. Motor runs only when control valve shifted.

Specifications: Weight 40 lb. Overall size 8¼" x 17" x 15¾". Rated at 1200 psi. Oil reservoir capacity is 1¾ gal. Model J-1 pumps 1 gpm, J-2 pumps 2 gpm.

Monarch Road Machinery Co.
Grand Rapids, Mich.

Circle **329** on Time-Saver Card

Continued on page 172

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

Capital Line Type Filter

Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- MONO-BILT 60 Mesh All Stainless Steel (Sump type).
- MONO-BILT Standard All Stainless Steel
- MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.
- LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

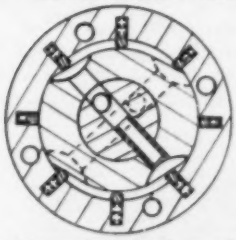
5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **31** on Time-Saver Card

Circle **110** on Time-Saver Card

Hydro-Wheel®
MAKES PLATFORM UNITS SELF-PROPELLED

Gives 360° Steering



- Simple, Safe, Easy-to-Install
- For Units of 1000 to 2000 lbs. Capacity
- Ideal for Narrow Aisles

Here is the new hydraulic wheel that makes "self-propelled" any platform lift unit of 1000 to 2000 lbs. capacity that uses an electrically driven hydraulic pump for lifting the load. Unit is installed by adding a valve and bolting on the Hydro-Wheel®, using the four bolt holes in the swivel block.
Hydro-Wheel® will rotate either forward or backward hydraulically, gives 360° steering. Safety valve protects battery and motor and prevents upsets by limiting size of obstruction wheel can climb.

We also manufacture

- Kingsbury Slipper Type rotary hydraulic pump for pressures to 2000 P.S.I.
- Tog-Oil® Double-Acting Differential Plunger Hand Pumps

WRITE DEPT. AP-5

MECHANISMS, INC.

118 E. 2nd St. • Uhrichsville, Ohio

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* Leather · Asbestos · Nylon · Vinyl · Teflon · Silicone Rubber · Neoprene · Rubber Cork · Fibre · Compositions · Phenolics · Cloth · Felt · Paper · Cardboard · Plastics Brass · Steel · Copper · Aluminum · Kel-F · Viton A · Mylar · Other Special Materials

Send specifications or blueprints for prompt quotations and recommendations. No obligation.

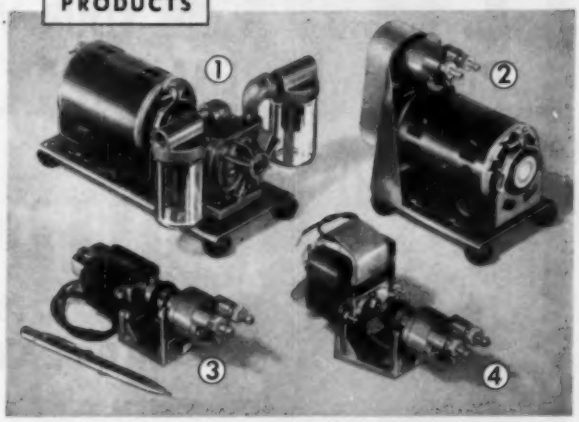
THE AUBURN MANUFACTURING CO.
308 Stack St., Middletown, Conn.

New York, N. Y.; Rochester, N. Y.; Detroit, Mich.; Chicago, Ill.; Minneapolis, Minn.; Pittsburgh, Pa.; Cincinnati, Ohio; Ridgewood, N. J.; Atlanta, Ga.; Memphis, Tenn.; St. Louis, Mo.; Washington, D. C.

Circle **18** on Time-Saver Card

ROTARY AIR
GAST
PRODUCTS

NEW for 1960



TWO TYPES OF MINIATURE OIL-LESS

GAST rotary vane VACUUM PUMPS and AIR COMPRESSORS

① Model 1030-V110-206 Vac. Pump, 1/20 h.p. Up to 1 c.f.m ; to 15" vac.

② Model 0330-V112-206 split phase 1/20 h.p. motor, .48 c.f.m. Up to 20" vac. or 15 p.s.i.g.

③ Model 0330-V102A-151 series wound motor. Up to .67 c.f.m. To 20" vac. or 10 p.s.i.g.

④ Model 0330-V110-202 shaded pole motor. Up to .35 c.f.m. To 20" vac. or 10 p.s.i.g.

⑤ (Below) Model 0630-P103 Compressor, up to .6 c.f.m. To 25 p.s.i.g. or 24" vac.

FOR ORIGINAL EQUIPMENT APPLICATIONS ON CONTROLS, INSTRUMENTS, BUSINESS MACHINES, LAB EQUIPMENT

Now — where space is very limited — you can provide moderate vacuum or pressure with one of these two types (3 series) of Gast semi-miniature Air Pumps.

They run entirely without oil. Carbon vanes lubricate themselves, producing a completely oil-free air blast or exhaust. Rotary design is simple, trouble-free and positive in air displacement.

The largest Model 1030 (1 above) delivers up to 1 c.f.m. running open at 3450 r.p.m. Model 0630 (5 below) has identical exterior, delivers up to .6 c.f.m. Smaller type 0330 (2, 3, 4 above) is shown with a choice of motors to suit various pump applications, both a.c. and d.c. With a rotor diameter smaller than a penny, Model 0330 produces up to .67 c.f.m. (open) at 6000 r.p.m.!

These "semi-miniatures" may solve a problem for you — investigate today!

WRITE TODAY FOR BULLETIN M-OVP.

GAST MANUFACTURING CORP., P.O. Box 117-D
Benton Harbor, Michigan

See Catalog in Sweet's Design File

GAST ROTARY
- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

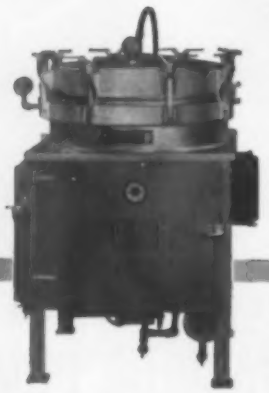
"Air may be your answer!"

Circle **68** on Time-Saver Card

LOWER YOUR VACUUM PUMP MAINTENANCE COSTS

with a

HILCO OIL RECLAIMER



HILCO Oil Reclaimer purifies vacuum pump oil by continuous recirculation, either on a full-flow or by-pass basis, or intermittently on a batch basis, depending on the requirements and physical layout of your plant.

HILCO OIL RECLAIMER SYSTEMS are the finest available for VACUUM PUMP users . . .

A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. A HILCO will produce and maintain oil free of all solids, sludge, acid, moisture, solvents, and dissolved gases and it will restore viscosity, dielectric strength and other specifications to new oil value. HILCO oil reclaimers are in wide use for purification of vacuum pump oil in many manufacturing operations.

• SPECIAL FEATURES •

- CONTINUOUS, ALL ELECTRIC, AUTOMATIC OPERATION
- LOW OPERATING TEMPERATURE
- VACUUM PROCESSING
- LOWERS VACUUM PROCESSING COSTS

THERE'S A HILCO FOR EVERY OIL PURIFICATION JOB . . .

FOR COMPLETE DETAILS, WRITE FOR BULLETIN R-160.

THE HILLIARD Corporation

148 W. FOURTH STREET
ELMIRA, NEW YORK

• IN CANADA •
UPTON-BRADEEN-JAMES, LTD.

890 YONGE STREET, TORONTO • 8760 VERVILLE STREET, MONTREAL

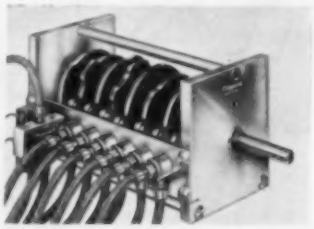
Circle **81** on Time-Saver Card

NEW PRODUCTS

PROGRAMMING UNIT . . . is air-electric

Designation: Minimatic

Features: End plates tapped for mounting bottom or rear. Self-lubricating bearings. ⅜" steel shaft



extends at both ends for tandem operation. Choice of eight standard cams. Specials available. Can be driven by any source of 10 in.-lb. torque.

Specifications: Overall size is 7⅛" x 3¼" x 4".

Clippard Instrument Laboratory, Inc.
Cincinnati, Ohio

Circle **330** on Time-Saver Card

BYPASS RELIEF VALVES . . . for oil to 325 psi

Designation: LFC-9, LFC-10, HFC-9

Features: Spring-loaded piston starts to open at set pressure. Opens

completely at higher pressure. Shearing action on closing. No chatter. Cast iron bodies have steel or stainless steel trim. With smooth-face flanges or rabbets, drilled on-center or off-center.

Specifications: Maximum control pressure of LFC-9 (2½" flange) is 60 psi. Maximum control pres-

Continued on page 174

Circle **44** on Time-Saver Card

AUTOMATING?

Keep It Simple

with the
ELECTRO-SNAP
One-Way Impulse
PRECISION
LIMIT
SWITCH

Type ES4-KM2 shown

Before finalizing design on your automatic tools or systems, get full details on the ELECTRO-SNAP ES4 family of switches. Many variations available . . . all trouble-savers!

- Fewer switches needed.
- Simpler, cheaper than timers.
- More reliable than fancy circuitry capable of same job.

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CONTROL SWITCH DIVISION

CONTROLS COMPANY OF AMERICA
4218 W. Lake Street • Chicago 24, Illinois
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Circle **132** on Time-Saver Card

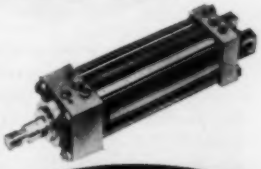
WHO'S SMILING?

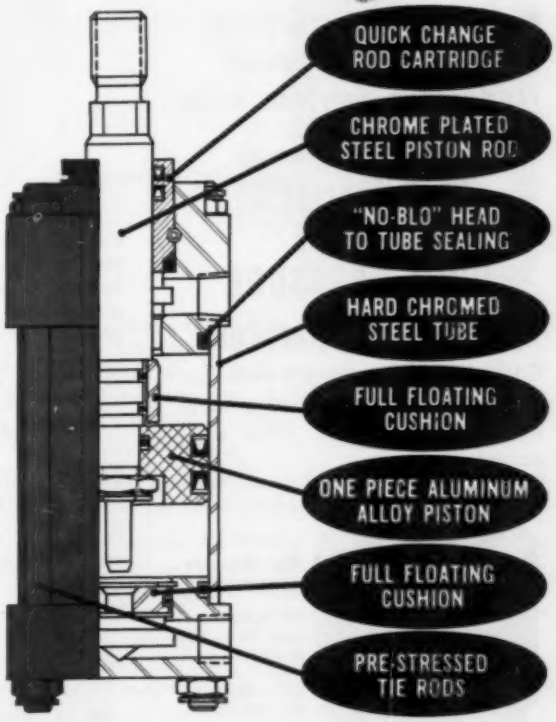
YOU, WHEN **YOU** DISCOVER THE DESIGN ADVANTAGES OF • • • •

LINDBERG

SQUAREHEAD CYLINDERS

DESIGN IN LINDBERG AND . . . ADD ALL THESE FEATURES!
and many more besides!




QUICK CHANGE ROD CARTRIDGE
CHROME PLATED STEEL PISTON ROD
"NO-BLO" HEAD TO TUBE SEALING
HARD CHROMED STEEL TUBE
FULL FLOATING CUSHION
ONE PIECE ALUMINUM ALLOY PISTON
FULL FLOATING CUSHION
PRE-STRESSED TIE RODS

CERTAINLY! Your choice of mounting styles • 7 bore sizes to 6" • Built to JIC recommendations • Standardized mounting dimensions.

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FOR DETAILS OF THESE AND MANY OTHER FEATURES, WRITE FOR THESE BULLETINS TODAY.

SQUAREHEAD "S" LINE—	BULLETIN S-101
2000 PSI "H" LINE—	BULLETIN H-101
HEAVY DUTY "A" LINE—	BULLETIN A-101

for fast action on "specials" tell us what you need.

LINDBERG AIR and HYDRAULIC DIV.
TEER-WICKWIRE & CO.
1802 WILDWOOD AVE. • JACKSON, MICHIGAN

Circle **154** on Time-Saver Card

Unretouched photomicrograph (100 x) shows steel particles which passed through an edge-type strainer with .003 in. spacing. The particles were extracted by a Frantz FERROFILTER.

Remove such ferrous particles from your Hydraulic System with

FERROFILTER®

HIGH PRESSURE Magnetic Separators

Get rid of the ferrous grit which can cause sticking valves as well as abrasive damage to finely fitted components.

Series PH High Pressure FERROFILTER

Working pressures from 2000 to 5000 psi; stock sizes—12 to 40 gpm (hydraulic fluid Mil 0-5605)

•

Low pressure models for 100 psi also available.

Send for BULLETIN HP

S.G. FRANTZ CO., Inc.

655 Kline Ave. & Brunswick Pike

P. O. Box 1138 Trenton 6, N. J.

Circle **62** on Time-Saver Card

NEW PRODUCTS

sure of LFC-10 (3″ flange) is 100 psi. HFC-9 has pilot operation. Has two springs, two pistons. 2½″ flange, 325 psi maximum pressure.

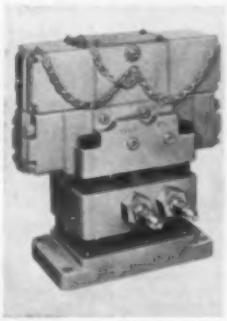
Fulflo Specialties Co., Inc.
Blanchester, Ohio

Circle **331** on Time-Saver Card

FLOW CONTROL VALVE . . . requires no piping

Designation: Circuitstak

Features: Valve is installed between a ½″, ¾″, or 1″ directional valve



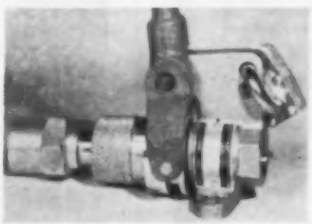
and subplate. Eliminates interconnecting lines. ¾″-dual valve with integral check allows adjustable metering-out in both lines, is non-pressure compensated.

Double A Products Co., Subs.
Brown & Sharpe Mfg. Co.
Manchester, Mich.

Circle **332** on Time-Saver Card

SLIDING SLEEVE VALVES . . . in tap sizes ⅛″ to 1″

Features: Valves make it safe to work on pneumatic machine when live air is in system. Keep machine from losing air pressure at wrong



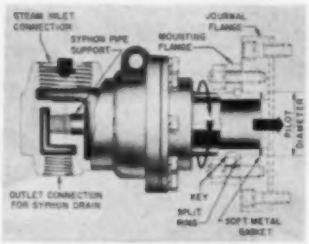
time. Save air during long shutdowns. Can be padlocked in off-and-exhaust or on-and-flow position. Used on inlet header of machine. Manual or spring-return. 2 and 3-way.

Hunt Valve Co.
Salem, Ohio

Circle **333** on Time-Saver Card

ROTARY JOINT . . . flange improves concentricity

Features: Eliminates threaded connection of rotary sleeve, sometimes difficult to disconnect from



rotating journals. Equipped with machined straight rotating sleeve. Joint attached to rotating device by mounting flange keyed to rotating sleeve. Secured with four nuts on mounting flange. Use wrench only for installation or removal. Soft metal gasket seals joint at end. Self-adjusting for wear.

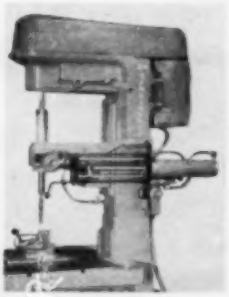
Specifications: Available in 2″, 2½″, 3″ sizes. To 400 psi cold operation, to 100 psi at 500 F. Either single flow or syphon flow service.

Barco Manufacturing Co.
Barrington, Ill.

Circle **334** on Time-Saver Card

AIR-POWERED DRILL PRESS FEEDS . . . have geared heads

Features: Transmission unit gives greater drill point thrust with short-



er stroke, or longer stroke at reduced thrust. Heavy-duty models have manual or electric control. Unit shown has guard removed. Transmission arm does not interfere with operator. Outside gears are interchangeable, pick-off type.

Specifications: On 1¼″ pinion shaft at 100 psi, stroke ranges from 8″ at 625 lb. maxmum thrust to 2″ at 2500 lb. maximum thrust.

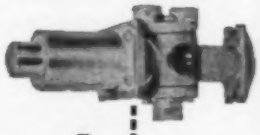
Beckett-Harcum Co.
Wilmington, Ohio

Circle **335** on Time-Saver Card

BLAMING COIL BURN-OUT ON THE SOLENOID? THEN TAKE A CLOSER LOOK AT THE **VALVE!**

~~SPOOL and POPPET Valves bind and stick as dirt collects... overload solenoid and cause coil burn-out.~~

"SHEAR-SEAL" Valves are not sensitive to dirt... always retain solenoid power margin.



D.C. SOLENOID "SHEAR-SEAL" VALVES 0 to 10,000 P. S. I.

A.C. SOLENOID "SHEAR-SEAL" VALVES 0 to 10,000 P. S. I.

EXPLOSION PROOF A.C. and D.C.

SOLENOID "SHEAR-SEAL" VALVES 0 TO 10,000 P. S. I.

~~SPOOLS and POPPETS leak... can't compensate for normal wear.~~

"SHEAR-SEAL" Valves stay leakproof... a spring takes up the normal wear.

ASK FOR CATALOG V-59-60

CONTROL VALVE DIVISION

Barksdale valves

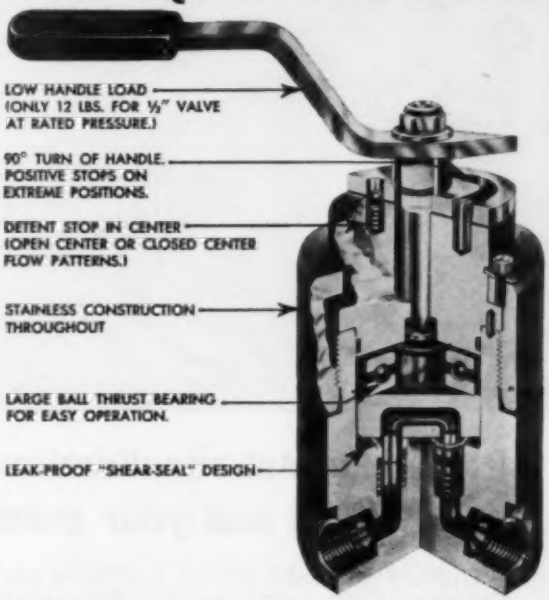
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **22** on Time-Saver Card

10,000 P.S.I.

4 WAY VALVE

FOR LIQUIDS OR GASES


LOW HANDLE LOAD (ONLY 12 LBS. FOR ½" VALVE AT RATED PRESSURE.)
90° TURN OF HANDLE. POSITIVE STOPS ON EXTREME POSITIONS.
DETENT STOP IN CENTER (OPEN CENTER OR CLOSED CENTER FLOW PATTERNS.)
STAINLESS CONSTRUCTION THROUGHOUT
LARGE BALL THRUST BEARING FOR EASY OPERATION.
LEAK-PROOF "SHEAR-SEAL" DESIGN

This new four-way valve series comes in pipe sizes from ¼ to 1 inch, but may be obtained with tube, AND 10050, or any preferred special high pressure connection. It will withstand surges of up to 15,000 P.S.I. without damage to the valve's sealing qualities. It is designed for a burst pressure of 30,000 P.S.I.

No port to port leakage occurs in the detented positions because of the exclusive "Shear-Seal" design.

Long, maintenance-free service is assured because the optically flat metal to metal sealing surfaces of the sealing rings and mating rotor faces are protected by staying in constant intimate contact; flow is always through the center of the "Shear-Seal", never across sealing surfaces (as in conventional valve design). Sealing qualities actually improve as the self aligning "Shear-Seals" lap themselves to a more perfect fit with each valve operation.

Of course, there is no external shaft leakage, because the pressure is confined to the flow passages.

This highly successful principle of extreme pressure control is fully described in "Shear-Seal" bulletin BVM-2.

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **23** on Time-Saver Card

The simplicity of recalibrating an RMC bimetal dial thermometer is illustrated below. *Patented RMC system leaves hermetic seal undisturbed, prevents damaging of critical pointer shaft.*

RMC external recalibration device saves time and your thermometer

With the patented RMC dial reset screw you can recalibrate your thermometer easily and safely, should it ever be necessary. The all-important hermetic seal cannot be destroyed, and there is no chance for damage to the critical pointer shaft.

What the RMC system of recalibration means to you

Sometimes it is necessary to recalibrate industrial thermometers due to severe shock from rough handling, or to calibrate for extreme accuracy at any point on the scale for special work range.

Various recalibration systems are employed in the different makes of ordinary bimetal thermometers. Most all of them will achieve the desired recalibration, but a number of undesirable things may also result. In some, all semblance of air-tight seal is automatically destroyed in removal of the dial glass. In others, the critical pointer shaft may become bent or twisted. And still others use a mechanism incapable of holding the new setting for any length of time. *None of these things can possibly happen with RMC's patented recalibration device.*

A simple dial-reset screw, located on the back side of RMC thermometers, permits recalibration without opening the instrument in any way—thus leaving its air-tight hermetic seal intact. Its positive meshed-gear mechanism rotates the dial itself in a way that cannot under any circumstances cause damage to the pointer shaft. And the new setting will hold indefinitely.

Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC., Rochester, N.Y.

Circle **137** on Time-Saver Card

USEFUL LITERATURE

Continued from page 76

HAND PUMPS

1000, 2500, 5000 psi. Single acting. With 60 lb. force on handle, .9, .4, and .17 cu. in. per stroke. Reservoir holds 60 cu. in. May be pressurized to 80 psi. Larger or smaller reservoirs—18 cu. in. per inch height. Suction, discharge, and release valves are interchangeable. Hex wrench removes them. 18″ handle. Alternate, horizontal handle socket available. Weighs 15 lb. Photos, drawing, chart. Bulletin 160 also shows boosters and air and hydraulic cylinders. *Sheffer Corp., Cincinnati, Ohio.*

Circle **408** on Time-Saver Card

CONTROL PANELS

Bulletin discusses location, good electrical and mechanical practices, codes and standards, enclosures, and safety precautions. Gives tips on specifying a control panel. Graphic representation of remote control system. Photos. List of organizations which publish control-panel codes and standards. Fact File ER-G-8. *Fuller Co., Catasauqua, Pa.*

Circle **409** on Time-Saver Card

O-RINGS

Tables of dimensions and materials. Brochure shows seals' temperature and chemical resistance. For gases and liquids. 8 pages. *Stillman Rubber Co., Culver City, Calif.*

Circle **410** on Time-Saver Card

BUTT-JOINT TUBE FITTINGS

Edge of sleeve meets fitting body, keeps fittings pressure-tight beyond tube's burst strength. Three serrations in sleeve create minimum stress concentration on tube. Nut covers body threads, gives visual indication of tight joint. No forward movement, no torquing of tubing. Shoulder on sleeve prevents reverse assembly, provides tube stop. Pressure-tight joint even when tube doesn't bottom on sleeve shoulder. Tube doesn't enter fitting body. No flaring. Bends can be closer to fittings. Greater latitude in tube placement. Catalog 3108 shows typical

layouts, port sealing methods, maximum working pressures. Flow nomographs, temperature, vacuum, vibration and shock data. Test report summaries, formulas, corrosion guide, photos, drawings, dimensions, assembly instructions. 44 pages. *Imperial Brass Mfg. Co., Chicago, Ill.*

Circle **411** on Time-Saver Card

THREAD COMPOUND

Lubricates and seals bolts, studs, and flanges. For high pressures. Temperatures to 1800 F. Non-settling, non-hardening. No galling. No seizing. Colloidal copper composition copper-plates metals. For metals, alloys, and plastics. *Felt Products Mfg. Co., Skokie, Illinois.*

Circle **412** on Time-Saver Card

TENSION & TORQUE CONTROL UNITS

For webs and filaments, automatic edgeguide installations, and electric or pneumatic eye controls. Specifications, charts, graphs. Application photos. For textiles, plastics, and metals. *Web Controls Corp., West Englewood, N. J.*

Circle **413** on Time-Saver Card

CONTROLLED SPEED SYSTEMS

Make any a-c motor a variable speed motor. Convert fixed power line frequency to variable frequency of 20 to 100 cps. To vary frequency, vary speed of Varidrive motor. Manual, remote, or

automatic controls. Handle a-c induction drive motors to 60 hp. Control—singly or together—many types of motors. For soft starting, dynamic braking, wide speed range, very high speeds, torque controls, creep speeds. Automatically distribute loads equally. Limit speed. No electronics. *U. S. Electrical Motors, Los Angeles, Calif.*

Circle **414** on Time-Saver Card

Continued on page 178

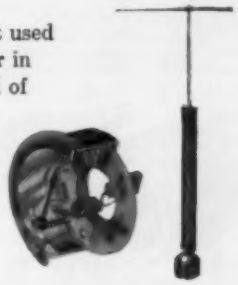
The photograph below shows RMC Pressure Gauges undergoing severe vibration testing on big Calidyne High Frequency Vibration Test System. These gauges undergo accelerated tests from 0-2000 CPS—up to 25 G intensity and up to 350° F.

RMC *direct-drive* Pressure Gauge eliminates vibration problems

The RMC *direct-drive* Pressure Gauge is rugged and resilient. It is the first direct-drive helical bourdon gauge—inlet pressure acts directly on a helical bourdon to drive the pointer. The helical coil, as a simple spring, is resilient and fully balanced, and is not affected by shock or vibration.

With its direct drive, there are no gears or linkage to gyrate and score on vibration—no unbalanced bourdon "C" springs and hair springs to whip. Direct-drive action means a stable pointer—no loss of power, too. Pointer action of the RMC gauge is steady, positive and alive—no need to tap the gauge to read. Soft hair springs and backlash springs are not used.

Shown at far right is the pointer-coil unit used in 3″ and 5″ concentric models. The pointer in these models is attached directly to the end of the pressure element. At the near right is a cutaway view of the compact 1½″ and 2″ eccentric models. The pointer in these models is actuated directly by a simple pivot. Both types offer the same direct-drive, helical bourdon advantages. Pressure ranges from 0-1000 to 0-10,000 psi.



Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

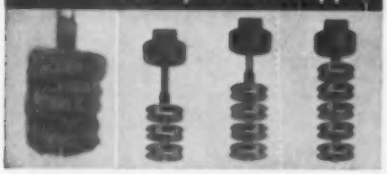
LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC., Rochester, N.Y.

Circle **138** on Time-Saver Card

Circle **92** on Time-Saver Card

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

USEFUL LITERATURE

SHAFT COUPLING

Flexible coupling allows slight angular and parallel shaft misalignment. Reuseable bushing—no need to replace entire sprocket when teeth become worn. Bushing makes coupling available immediately from stock—no reboring. Double-width precision chain conforms to ASA. Double rollers. Additional bearing area permits higher hp, longer wear life. To disconnect shafts, remove the one coupling pin. Bulletin A691 has hp ratings at various rpm. Aluminum covers available. *Dodge Mfg. Corp., Mishawaka, Indiana.*

Circle **415** on Time-Saver Card

HYDRAULIC RESERVOIRS

No dirt traps, hidden corners, internal welding, or scale. Recessed sight gage in each end cover is heatproof, shockproof. Holes for lines into reservoir are in plates fastened to reservoir top. For more down lines plates are removed and drilled. No need to disturb reservoir installation. Interchangeable parts. One center bolt fastens each end cover to center baffle. Pressure of stressed end cover compresses neoprene seal. Capacities from 10 to 120 gal. *Hydro-Craft, Inc., Detroit, Mich.*

Circle **416** on Time-Saver Card

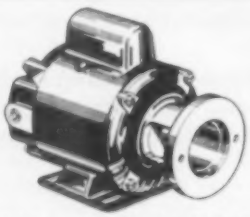
PEAK PRESSURE GAGE

Indicates hydraulic peaks over 0-4000 psi and 0-10,000 psi ranges. Can be used for permanent recording. Folder gives specifications, method of operation, and typical wave forms encountered. *Hydel, Inc., Waltham, Mass.*

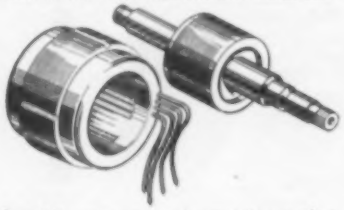
Circle **417** on Time-Saver Card

GASKETING & GASKETS

Palmetto 2940 for heavy hydraulic service. Cotton duck between layers of synthetic rubber. Cured to permanent bond. Ply of cloth for each 1/16" thickness of finished sheet. 2950 diaphragm sheet for reducing valves and regulators. Press curing produces uniform density and smooth, tight-grained surface. Ring and full-face gaskets of com-



Special flange construction for hydraulic pump applications. Motor design to be polyphase and capacitor with special machined shafts, mounting arrangements and other mechanical elements.



Special motor parts to meet exacting design requirements . . . torque, envelope, temperature and atmosphere.

J&H *Customized* ELECTRIC MOTORS

J & H *Customized* Motors are built to meet problems of individual design, exact operating conditions and space limitations. A-C induction motors—single and three phase, in ratings up to 3 hp (up to 15 hp for submersible motors). Prompt quotation follows receipt of your inquiry. Write Jack & Heintz, Inc., 17626 Broadway, Cleveland 1, Ohio.

Submersible motors or parts with length/diameter ratios to fit special requirements. For operation in water, oil, gasoline or other fluids.

Special low silhouette motors to meet specific space limitations of diameter, length or height.

DESIGN YOUR PRODUCT TO DO A JOB—NOT TO FIT A MOTOR

Customized JACK & HEINTZ ELECTRIC MOTORS

pressed asbestos. Homogeneous—no ply separation. Long-fibre asbestos pressure-bonded with GR-S. Catalog 1259 covers other products. Photos. Charts of dimensions. *Greene, Tweed & Co., North Wales, Pa.*

Circle **418** on Time-Saver Card

QUICK COUPLERS, FITTINGS & VALVES

Catalog tells when automatic, semi-automatic, and regular couplers are economical for oil, air, or

grease. Shows couplers, fittings, and 3-way sleeve valves for air tools and fixtures. 20 pages. *Foster Mfg. Co., Inc., St. Louis, Mo.*

Circle **419** on Time-Saver Card

STAINLESS STEEL PIPE & TUBING

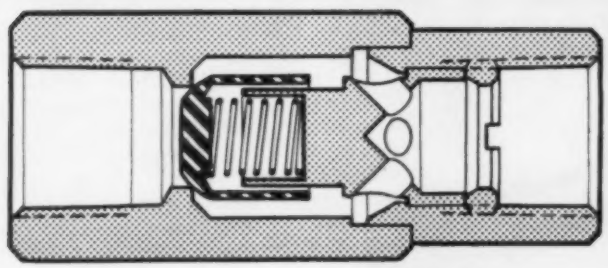
In sizes from ⅛" to 6". Wall thicknesses include American Standard Schedules 160, 80, 40, 10, 5. Standard and special shapes. Lengths over 40 feet. Booklet has tables of length, ID, OD, and ovality tolerances. Chart of resistance of stainless steels to various media. Stainless Steel Finder shows physical, electrical, and mechanical data, analyses, heat resistance, working and treating temperatures, mechanical properties, and creep strength. Chart shows which types meet military specifications. Tables of area factors, and theoretical weight of tubing. Photos of tubing applications. 34 pages. *Allegheny Ludlum Steel Corp., Pittsburgh, Pa.*

Circle **420** on Time-Saver Card

ACCUMULATORS

5 blade V-O-ring maintains contact between piston and wall. Does not roll, even under rapid cyclying. Holds full pressure throughout long idle periods. Sizes from 10 cu. in. to 10 gal. Bulletin 1530B1 explains uses of accumulators. Circuits. For petroleum or water base fluids.

Continued on page 180



Dependable Check Valves

- **Can't stick open**
- **Low pressure drop**
- **Tight metal seal**

Write for detailed literature

- All steel construction
- For oil to 5000 psi
- Sizes — ¼" thru 1¼" pipe (NPTF) or S.A.E.

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

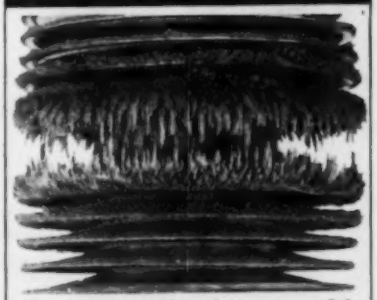
1284 N. CENTER STREET • MENTOR, OHIO

Member of National Fluid Power Association

Circle **180** on Time-Saver Card

meet a strainer with a magnetic personality

Ripley Magnetic Sump Strainers combine powerful built-in Alnico magnets with efficient, removable filter discs for 2 way protection—all in one compact unit!



The above section shows powerful magnetic attraction of the entire strainer assembly. Designed to meet J.I.C. Specifications for magnets in hydraulic systems . . . these Ripley Strainers require no extra openings in the reservoir, and disassemble for quick, easy cleaning. They are available now in a wide range of sizes. Write today for complete data!

RIPLEY

SCREEN AND STRAINER CO.
Filter Division
32749 Northwestern Hwy., Farmington, Mich.

Circle **135** on Time-Saver Card

USEFUL LITERATURE

Temperatures from —40 to 200 F. Special seals for —65 to 400 F. Pressures to 3500 psi. Drawing. Table of dimensions. 4 pages. *Parker Hydraulics Div., Parker-Hannifin Corp., Cleveland, Ohio.*

Circle **421** on Time-Saver Card

HIGH PRESSURE TEST EQUIPMENT

Valves for liquids and gases to 150,000 psi. Differential-piston pressure balance for 45,000 psi. Accuracy is 1:10,000. Intensifier-type balance (used with above) for pressures to 90,000 psi. Test units generate 45,000-150,000 psi hydraulic pressure. Operated by hand-pumps or mechanically-driven pumps. Mercury-piston gas compressors are oil compressors with mercury seal between oil and gas chambers. For pressures to 60,000 psi. Diaphragm-type pressure gages for 45,000 psi. Accurate to 1:500. *Hart & Zn., Rotterdam, Holland; available from High Pressure Equipment Co., Erie, Pa.*

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FLANGE-TYPE FITTINGS

For hydraulic systems. Flange plates have SAE bolt spacing outlets. Tube outlets of elbows and tees can be perfectly aligned with piping. Eliminate possibility of damaging components because of faulty pipe tapping, or over-torquing. Reuseable after several disassemblies. No contamination of system from pipe compounds. Flange plate doesn't loosen under severe vibration. Replace taper pipe thread ports in components which use large tubing, hose, and pipe. Thirty models. Flared tube, dryseal pipe, weld and solder attachments. Straight, 90-deg., and 45-deg. angles. Male and female. Several tee combinations. Diagrams and dimensions. *L&L Mfg. Co., Warren, Mich.*

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CORROSION RESISTANCE RATING GUIDE

Lists corrosion resistance of ball valve materials—aluminum, carbon steel, semi-steel, 316 stainless steel, Buna N, Neoprene, Viton A, Teflon Nylon, and Kel-F. Lists 390 fluids from Acetaldehyde to Zinc Sulphate. Tells whether use of material with fluid is especially suitable, usually satisfactory, good, or unsatisfactory. *Hydromatics, Inc., Livingston, N. J.*

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CYLINDERS, BOOSTERS, ACCUMULATORS, FITTINGS

Model A air cylinders have 1½" to 20" bores. To 750 psi. 17 mounting styles. Strokes to 22 feet. Cushion optional. Single or double rod end. Model H hydraulic cylinders for 5000 psi. Model J for 2500 psi. Cutaway diagrams and callouts describe cylinders. Charts of bores, rod diameters, rod turndown and threads, strokes. Charts of stroke thrusts. Drawings, dimensions. Air-oil circuits and components covered. Tanks, tandem cylinders, boosters, and accumulators. Pipe thread seals eliminate positioning problems. Bulletin P2547P. *Miller Fluid Power & Tru-Seal Divisions, Flick-Reedy Corp., Bensenville, Illinois.*

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PRECISION
BORED and HONED PARTS
by
American

If your deep bored and honed part is up to 16" I.D. and up to 40 ft. long, we are equipped to meet your exacting specifications. We have the tooling and the experienced skills to produce hollow parts to any internal or external finish desired. We are equipped to supply flanged or pad weldments and to work in any materials to any physicals required.

American's special boring and honing service is described in a 20 page brochure. Write for a copy.

AMERICAN HOLLOW BORING CO.

You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

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DUAL Purpose...

250 psi AIR to 2000 psi HYDRAULIC

ONE Price...

EVEN WHEN
MODIFIED WITH TAPERED CUSHIONS
FOR LOW PRESSURE HYDRAULIC SERVICE!

FINEST OF THE INTERCHANGEABLES is this improved new dual-purpose C5 SERIES Air Cylinder from Sheffer of Cincinnati, machine tool center of the world. The ultimate in design, construction and performance. Long, low-cost service life. Write NOW, for NEW BULLETIN NO. 459.

- 250 psi AIR—to 2000 psi HYDRAULIC
- 12 BORE sizes—1⅛ to 14
- CARTRIDGE quickly removed without disassembly
- Sturdy STEEL head construction
- Meets or exceeds JIC standards
- INTERCHANGEABLE with other makes

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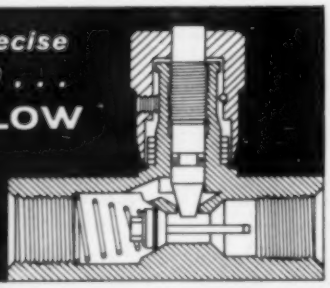
COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- For oil, gas, vacuum, water and other fluids
- Pressures: Brass to 2000 psi Steel to 5000 psi
- Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads

- Simple reading, recording, setting and adjusting
- Safe — adjustable under pressure
- Setting can be locked to hold adjustment
- Extremely sensitive — provides high flow and minimum pressure drop

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THE MANATROL Corp.
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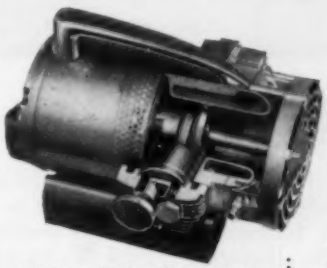
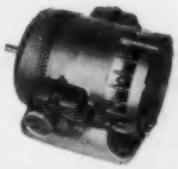
Oil-Free COMPRESSED AIR FROM YOUR CHOICE OF 58 MODELS

Completely oil-free air—no lubrication ever needed when you choose one of these 58 B&G Oil-less Compressors. Carbon graphite piston rings and skirts need no lubrication—motor bearings are *permanently* lubricated. Numerous other design and construction features assure long life and smooth dependable delivery of cleaner, cooler, drier air.

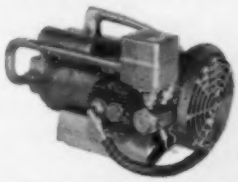
For portable or built-in applications, these lightweight, compact compressors give maximum air per horsepower.



Oil-less Motor Compressor Units—35, 75 and 175 lb., single and two-stage, ¼ to ¾ H.P.

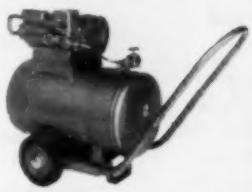


Bare Compresser (less Motor)—35, 75 and 175 lb. pressures, for belt-driven applications.

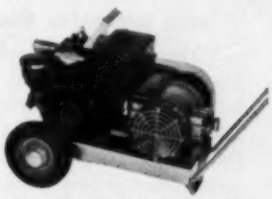


Tankless Motor-Compressor Outfits—for use where existing air tanks or pipe lines provide air storage. 35, 75, 175 lbs., single and two stage. ¼ to ¾ H.P.

"Piggy-Back" Compresser Tank—Handy 2-gallon tank mounts on any B&G 75 or 175 lb. Motor Compressor or Tankless Outfit.



10-Gallon Air Tank Motor-Compressor Outfits. 35—175 lbs.—mounted on Code or non-Code Tanks. Portable when cart-mounted.



Gasoline Engine-Driven Compresser Outfits—Weighs only 55 lbs., compact, cart-mounted. Delivers air up to 90 psig. continuously.

Vacuum Pumps—will pull up to 28" vacuum—continuously! Oil-less construction means no messy discharge vapors.

30-Gallon Air Tank Motor-Compressor Outfits—75 and 175 lb. units. Vertical or horizontal ASME Code tanks tested to 400 lbs. ¼ to 1½ H.P.

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Oil-less AIR COMPRESSORS

BELL & GOSSETT COMPANY
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Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ont.

Circle **25** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Roper names Dorland sales manager

Roper Hydraulics, Inc., Commerce, Georgia, has made George Dorland sales manager. He joined the firm early in 1957. Dorland will supervise 23 district sales offices in the United States and Canada.

Dorland

Garwood

Vickers promotes Garwood

Vickers, Inc., Detroit, Mich., has promoted John H. Garwood to the post of director of organization planning. He handles the firm's organization and management development programs. He was director of salaried personnel.

Sheffer holds sales meeting

The second annual sales conference of The Sheffer Corp. will be held May 19th and 20th at the Carrousel Motel in Cincinnati. Work sessions will be for both inside and outside salesmen.

Denison forms North Central sales region, names three

D. J. Arnold will head a new sales region for Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio. Under Arnold will be district offices in Detroit, Pittsburgh, and Dayton. The sales area includes Ohio and parts of Michigan, Pennsylvania, West Virginia, and Kentucky. As regional product sales manager, John W. Lindsay will direct engineering and application of hydraulic Multipress equipment. The regional office is in Cleveland, Ohio. Denison has made J. D. Schaffner field engineer for the St. Louis, Mo., area. Territory includes southern Illinois, Iowa, Missouri, and Nebraska.

Dynex opens New York office

Dynex, Inc., Pewaukee, Wis., has opened a regional office at 361 Merrick Rd., Lynbrook, L. I., N. Y. B. C. Buongiovanni is in charge.

Webster and Dykes take posts with Payne

Payne Mfg. Co., Inc., Houston, Texas, has chosen W. E. Webster vice president and general manager. B. H. Dykes is now sales manager for domestic and foreign operations.

O'Rorke is Parker-Hannifin district manager

Parker-Hannifin Corp., Cleveland, Ohio, has selected Thomas F. O'Rorke to be district manager of distributor sales for Michigan, except metropolitan Detroit. He will handle products of the firm's Hannifin Co., Parker Fittings & Hose, and Parker Hydraulics Divisions. He was a sales engineer with a Kalamazoo construction equipment company.

Southern California firms merge

Sweetland Co. has merged with Hydraulic Equipment Co. They will do business as the Sweetland Co. Last year, Sweetland became affiliated with Westec, Inc., Compton, Calif.

Aldrich promoted at Brooks

John T. Aldrich has been named sales manager of Brooks Rotameter Co., Hatfield, Mass. He has been with the firm for ten years, as assistant sales manager and production manager.

Precision Rubber opens new branches

Precision Rubber Products Corp., Dayton, Ohio, has opened direct-factory branches in Kenilworth, N. J. and Wellesley, Mass. The branches stock the firm's O-rings and provide engineering and

Figley

Carver

product design service. Territory includes New England, Metropolitan New York, Long Island, and the eastern parts of New York, Pennsylvania, and New Jersey. William Figley manages the Kenilworth branch. He was brought in

Continued on page 184

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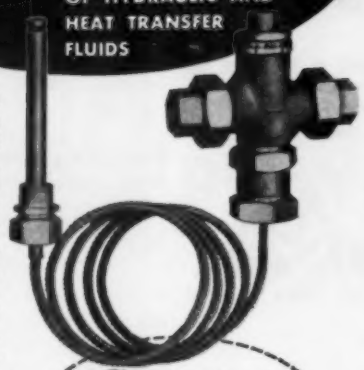
Accurate, Automatic temperature control

OF HYDRAULIC AND HEAT TRANSFER FLUIDS



Peak performance of hydraulic equipment is assured by the precise, dependable oil temperature control maintained by the Sterlco Temperature Control Valve, Series 150E. It's completely automatic, self-contained, compact and low cost . . . operates in any position. Write for details.

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Series 150E

Leaders in temperature controls since 1916

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Industrial Control Division

Make a good valve — — — — even better!

HADBAR bonded fluorosilicones improve component reliability in missile check-out systems. The bonded seal on this valve is resistant to fuels, nitrogen and helium...is compatible with LOX cleaning methods...functions in a temperature range of −80°F to +300°F. HADBAR may have the answer to your specific requirements in molded, extruded and bonded applications.

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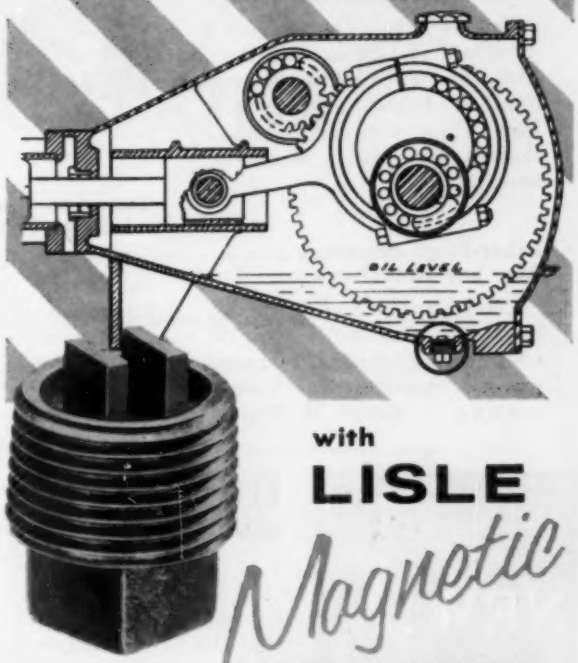
STOP TROUBLE BEFORE IT STARTS



with **LISLE** *Magnetic* **PLUGS**

An independent report shows that pumps last up to 3 times as long in hydraulic systems protected with Lisle Magnetic Plugs. Clogging and fouling of valves is also radically reduced.

Installed in the flow path or sump, the Lisle Magnetic Plug picks up ferrous particles circulating in the fluid . . . thus eliminating a primary cause of wear.

LISLE CORPORATION
CLARINDA • IOWA

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POST SCRIPTS OF INDUSTRY

from Chicago. John Carver, formerly manager of the firm's Indiana territory, manages the Wellesley office and warehouse.

Chiksan Export Co. becomes Chiksan International

Chiksan Export Co., formerly a subsidiary of Chiksan Co., Brea, Calif., is now Chiksan International, a division of the parent firm. There were no personnel changes. The division remains at Brea.

Luber-Finer advances four key executives

Luber-Finer, Inc., Los Angeles, Calif., has promoted Clarke Silcott, general manager, to executive vice president and general manager. Robert D. Buckles, sales manager, is now vice president and director of national and international sales. W. W. Boggs, secretary-treasurer, has been made vice president, production, and secretary-treasurer. D. B. Bogardus, assistant secretary and assitant treasurer, is now secretary and assistant treasurer.

Buckles

Potts

Canadian firm advances Potts

M. C. Potts has been named executive vice president of Dowty Equipment of Canada Ltd. As a director of Dowty Mining Ltd., Ajax, Ontario, Potts has traveled extensively in Canada and the United States.

Kist to cover Europe for Parker Seal

Parker Seal Co., Div. Parker-Hannifin Corp., has chosen John Kist as its European representative. He was a service representative with the Royal Netherlands Aircraft Factory. He works out of Amsterdam, Holland. Territory includes all Europe outside the Iron Curtain.

Bendix Aviation announces four appointments

Bendix Aviation has promoted Dr. Russell D. O'Neal from general manager of the Bendix Systems Division, Ann Arbor, Mich., to corporate vice president, engineering. The Systems division and the Research Laboratories division, Detroit, are under him. Roy J. Sandstrom, former assistant general manager of the Systems division, is now general manager. Before joining Bendix last year, he was vice president, engineering, of Bell Aircraft Corp. L. B. Young,

Continued on page 186

HYDRONIC
REMOTE CONTROL SYSTEM

PRECISE MANUAL MOTION DUPLICATION UP TO 100 FEET AWAY

Ideal for smooth, positive control of valves, variable displacement pumps, etc.

The HYDRONIC System is a distinct advance in the remote control field. It offers all the advantages and simplicity of a self-contained hydraulic system. Backlash, motion inaccuracies and installation difficulties inherent in mechanical linkages or push-pulls are eliminated. The HYDRONIC System is unaffected by wear and vibration.

Master and slave maintain perfect synchronization even under wide temperature changes through 114° arc with 500 in. lbs. output in either direction. A simple adjustment permits instant relative positioning between master and slave.

Write for complete information today.

HYDRONIC CORPORATION

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Detroit 39, Michigan

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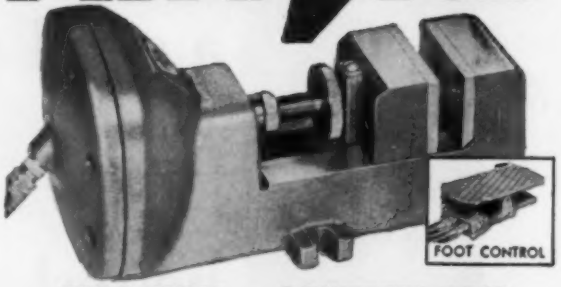
Speedy AIR VISE



HIGH SPEED · POWERFUL GRIP

New, improved model speeds up all repeat operations—*milling, drilling, tapping, punching, bending, riveting.* Both hands left free to produce more! Light squeeze to 2250 pounds pressure! Extra thick jaws for attaching jigs. Jaws open to 3-inches; 1/16" to 5/8" maximum travel. Complete with foot control, air hose and fittings..... $44.00

SPEEDY AIR REGULATOR
Regulates pressures 0 to 140 lbs.
No. 622 $7.25

SPEEDY AIR FILTER
Assures clean, oil-free air.
No. 140 $4.00

SPEEDY UNIT
Production spray unit with Ext. Mix Gun.
No. 705 $26.50

Order from Your Supplier or Write for Air Tool Catalog
W. R. BROWN CORP., 2655 N. Normandy Ave., Chicago 35

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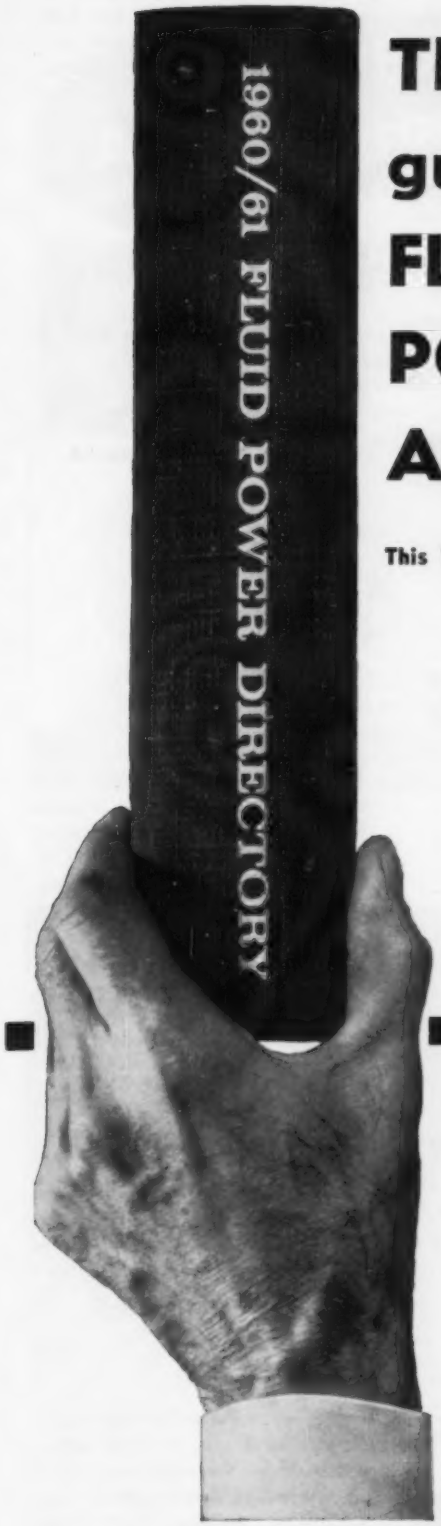

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This 1028 page volume includes:

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- ***DESIGN MANUAL—circuits, nomographs, designs and applications: a complete handbook for industrial, mobile and aviation systems.***
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POST SCRIPTS OF INDUSTRY

who headed long-range planning for the division, was made assistant general manager. He joined the systems planning group of Bendix in 1955. Edward J. Strong is Southwest regional manager for the Industrial Controls Section. He heads sales of machine tool numerical controls in Arkansas, Colorado, Kansas, Louisiana, Mississippi, Missouri, Nebraska, New Mexico, Oklahoma, and Texas. He was a machine tool sales engineer in East Texas.

Three win promotions at Flick-Reedy

Miller Fluid Power Div., Flick-Reedy Corp., Bensenville, Ill., has promoted Charles W. Dauer to district sales manager for New York (except the southeast section), northwestern Pennsylvania, Cleveland and Ohio's northeast lake section, Iowa, Minnesota, Quebec, and Ontario. Dauer joined the firm in 1949. Emil Galandak takes Dauer's former post of chief sales engineer. Galandak joined Miller in 1957, as a sales engineer. Robert E. Wilshek has been promoted to district sales manager for California, Colorado, Idaho, New Mexico, Utah, Washington, Oregon, Oklahoma, and Texas. He joined Miller in 1956. He has been personnel manager and a field engineer. The three will also serve in these capacities in Flick-Reedy's Tru-Seal Div.

Dauer

Galandak

Wilshek

Walker joins Besler Corp.

John F. Walker has become a sales engineer for Besler Corp., Oakland, Calif. He has research, engineering, and sales experience.

Skinner appoints Bruce White

Skinner Chuck Co. has made Bruce A. White a field representative for its chuck and valve lines. He will cover western Massachusetts, eastern New York, northern Connecticut, and Vermont. He was in the valve manufacturing department.

Continued on page 188

ON THE JOB...
with CROSS
HYDRAULIC CYLINDERS
Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!
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DEPENDABLE
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CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION
Try CROSS CYLINDERS in your operation ... low cost, dependable, and trouble free.
Lowest-Priced Engineered Quality Cylinders Available..
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AIR VALVES from stock

A complete range of two, three and four-way valves in sizes ¼", ⅜", ½", ¾".

- **High quality—Low cost.**
- **Compact—Light weight.**
- **Fast delivery from stock.**
- **Simplified design—Easy maintenance.**

Double solenoid, ball-detented model shown.

AIR VALVES COMPANY
24581 Groesbeck Hwy., Warren, Mich.

NEW! KEPNER Kepsel

The Check Valve that cuts costs of Design and Installation 75% and more!

- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

Write for complete technical data

*Patent Applied For

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syn-on-y-mous with dependable air supply

Where dependable compressed air supply is a "must" there's likely to be a Brunner air compressor. Installation after installation proves Brunner air compressors . . .

1. Are outstandingly dependable
2. Offer single or 2 stage equipment in all sizes
3. Supply complete air or water cooled aftercooler assemblies with all fittings from one dependable source for all compressor sizes
4. Provide "entire system" duplex units that are "operation readied" to connect to piping and wiring facilities
5. And the air conditioning and heating experience of Dunham-Bush engineers enables them to professionally assist in layout for dependable control systems.

also **WATER COOLED AFTER COOLERS AND OTHER ACCESSORIES BY heat-x A DUNHAM-BUSH SUBSIDIARY**

REQUEST:

- *Bulletin #763 for water cooled specifications*
- *Catalog #36A for ½ through 20 H.P. data*
- *Catalog #653A for consolidated listings ¼-50 H.P.*

BRUNNER DIVISION
DUNHAM-BUSH, INC.
DEPT. AH, WEST HARTFORD 10, CONNECTICUT

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POST SCRIPTS OF INDUSTRY

Monsanto appoints three in marketing

Monsanto Chemical Co.'s Inorganic Chemicals division has promoted Thomas F. Gogan from manager, district sales office, Boston, Mass., to manager of the New York City sales office. Franics J. Fitzgerald, assistant manager, district sales office, New York City, replaces Gogan at Boston. Robert E. Burke has been transferred from the St. Louis office to replace Fitzgerald.

Air Valves names Mattise

Robert Mattise has joined Air Valves Co., as a factory field engineer. He works out of the factory offices in Warren, Mich.

Larson joins Rucker sales engineering staff

The Rucker Co., Oakland, Calif., has added Glen R. Larson to its sales engineering staff. He has a broad background in industrial research and design.

Larson

Jordan

Alta appoints Jordan to Salt Lake City staff

Jerry Jordan is now a sales engineer for Alta Engineering Co., Salt Lake City branch. He was in design engineering with Industrial Physics & Electronics Co., and Sperry Utah Engineering Laboratory. The branch office is assigned Utah and Idaho territory.

New distributors

H. U. Rogness, Inc., Minneapolis, Minnesota, will distribute accumulators made by Parker Hydraulics Div., Parker-Hannifin Corp., Cleveland, Ohio. *Mills & Lupton Supply Co., Chattanooga, Tenn.,* will handle Crown compressed air system components of Parker's Hannifin Co. Div., Des Plaines, Illinois. *Staver Hydraulics Co., Schenectady, N. Y.,* will handle the Crown line, and tube and hose fittings of Parker Fittings & Hose Div., Cleveland, Ohio.

Fluid Control Div., Petroleum Engineering Service, Charlotte, N. C., will distribute in the Carolinas for Sheffer Corp. *Rosseau Controls, Ltd., Montreal, Quebec,* will handle Sheffer products in Ontario.

Syracuse Supply Co., Schenectady, N. Y., is now a distributor for Republic Mfg. Co., Cleveland, Ohio.

A-R-G Fluid Power, Inc., Rochester, N. Y., will represent Galland-Henning, Nopak Div., in western New York.

HIGH PRESSURE PUMPS
Standard and Special

Model S-216-C Series. Measures 8¼" wide x 9⅝" deep.

Air driven. For oil or water service. Eight standard models. Other models for lower or higher pressures. Thousands in use with a 12-year record for dependability. Applicable wherever low-volume output at high pressures is the requirement, such as static testing, powering presses, forming, clamping shearing, etc. Complete power packages also available. Send for bulletins.

OPERATING CHARACTERISTICS MODEL S-216-C

Model No.	Max. Input Air Pressure	Discharge Pressure at 100 psi Input Air Pressure
S-216-C-10	150 psi	1,100 psi
S-216-C-20	150 psi	1,800 psi
S-216-C-35	150 psi	4,600 psi
S-216-C-60	150 psi	6,600 psi
S-216-C-100	150 psi	8,800 psi
S-216-C-150	150 psi	15,200 psi
S-216-C-200	150 psi	23,750 psi
S-216-C-300	100 psi	33,500 psi

SPECIAL PUMPS—A wide selection of special pumps is also available for various pressures and service. These include ratios down to 1-to-1 and up to 500-to-1, special materials for volatile and corrosive fluids and designs to suit specific working problems. We invite your inquiries relating to special problems.

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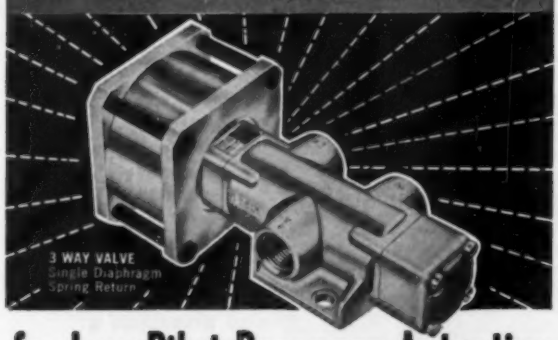

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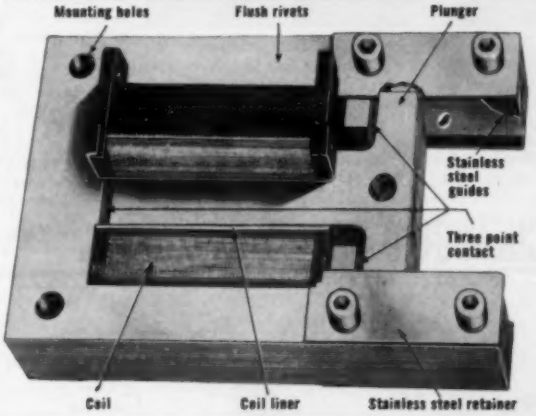

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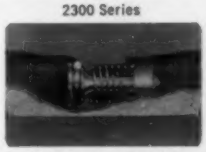

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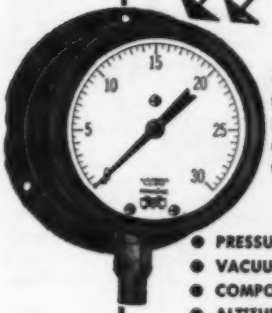

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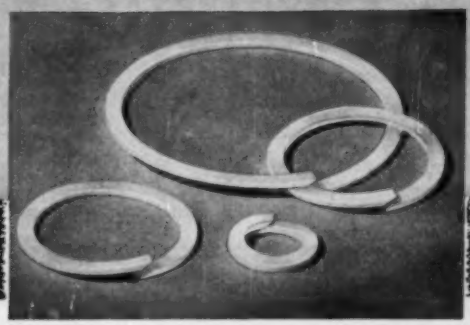

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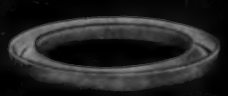

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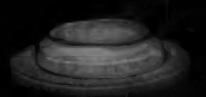

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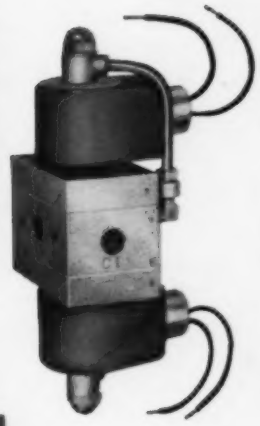

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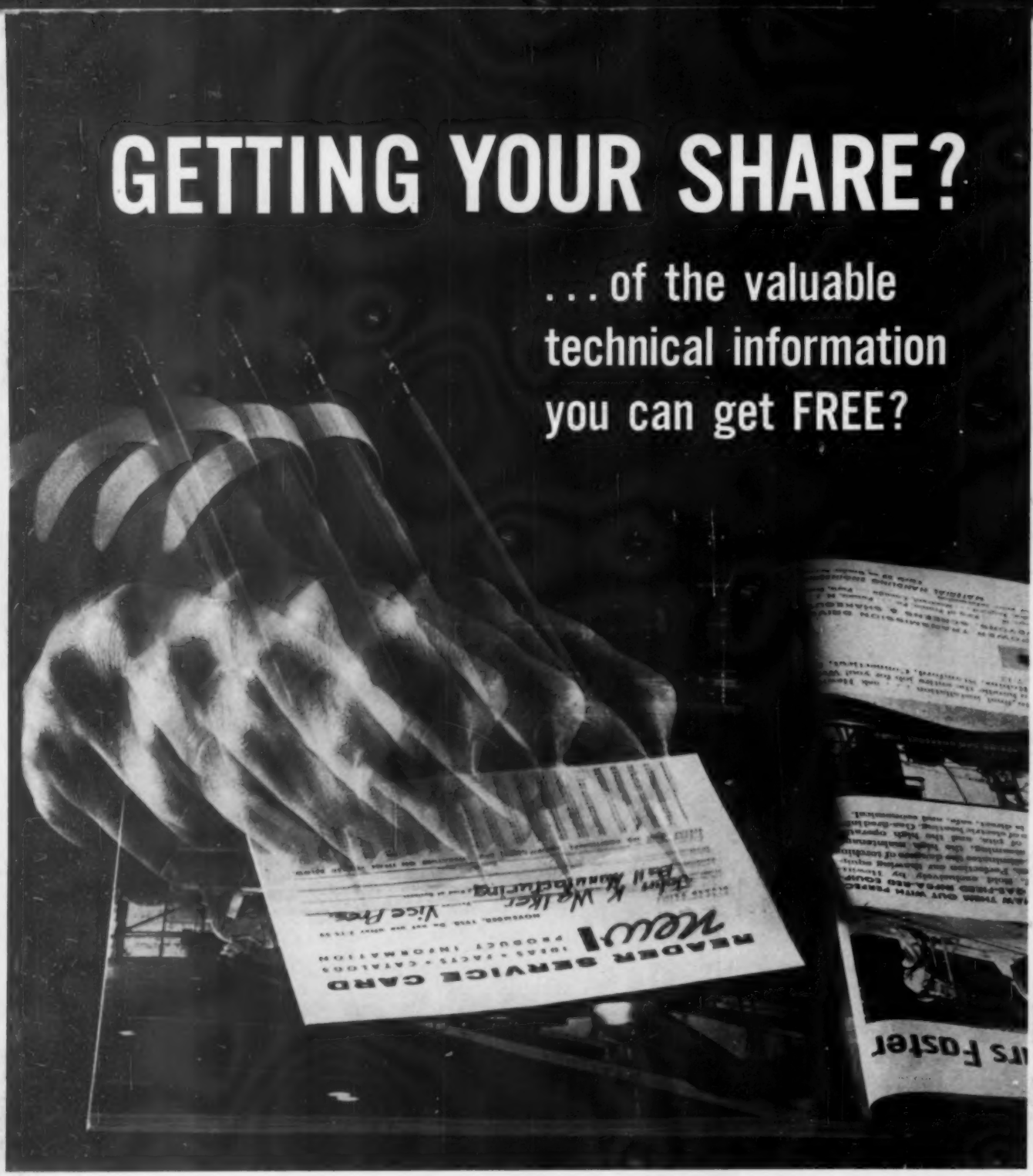

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